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Final Engineering Report on Production Engineering Project PE-559

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Methyl Centralite Coated M10 Propellant for the 25-mm Bushmaster Gun Projectiles

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| 20. | Methyl centralite deterred, seven-perforated, M10 was developed for the APDS round. Lots RAD-PE-559-15 and RAD-PE-559-16 were accepted by FACC. Field testing of lot RAD-PE-559-15 gave excessive noise and flash. As a result, potassium nitrate salt was added to the charges of lot RAD-PE-559-16. Field testing of this lot was acceptable. However, subsequent lots incorporating increased levels of potassium sulfate, added in the chemical formula to reduce the noise and flash, |
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| | created excessive gun pressures. Production of subsequent lots was initiated to meet new requirements of FACC with respect to noise, flash, high gun pressures, increased projectile weights as well as adjusted ballistic requirements. |
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INTRODUCTION

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The main sections of this report discuss the following seven phases of work:

RAAP gun test facilities 1.

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- Evaluation of existing RAAP propellant at FACC
- RAAP laboratory and closed bomb studies of potential SP and MP foreign and CONUS reference propellants
 - Propellant processing
 - 5. Propellant coating
 - Chemical, physical, and internal ballistic tests
- Gun testing and recommendations for a future project to improve propellants.

Work in most areas of this project was conducted on a best-effort basis with limited fundings. The work on pilot lots had been completed and production-sized lots had been produced before formal specifications developed and unsatisfactory characteri, tics associated propellant for the APDS-T projectile were reported by the customer. performed all gun acceptance and evaluation tests for all pilot lows produced for this project including the final 1000-pound model lot (RAD-PE-559-11) and two production lots (RAD-PE-559-15 and 16) for the APDS-T projectile. Some gun tests at 21°C (70°F) were performed at limited and outmoded ammunition components fo: with RAD-PE-559-11, 12, 13, 14, 15. and 16 with the APDS-T projectile.

A new gun and components were provided to RAAP for all subsequent Also, all subsequently produced or modified lots were tested at both RAAP and FACC using a partially standardized reference propellant (Lot RAD-PE-559-16 modified by addition of 0.5 g potassium nitrate salt).

ENGINEERING EFFORT

Work Scope and Specification

Propellants for the AP-T, HEI-T, and APDS-T rounds of ammunition of the Bushmaster weapons system were developed into the production stage as the result of this project. As directed, RAAP produced propellant to a series of evolutionary specifications, see appendix A. Coated propellants to be used in lieu of target lots P-2078 and P-1929 were produced. Also evaluated was whether a single propellant, such as CIL lot 5554, could be used for all projectiles. At a meeting on 11 December 1975 of FACC, Frankford Arsenal, Hercules Incorporated, and RAAP Contracting Officer's personnel, agreements upon tasks incidental to these accomplishments were made.

The tasks undertaken by RAAP at the beginning of this project were:

- 1. Receive and evaluate Oerlikon propellant lots P-2078 and P-1929 from Wimmis, Oerlikon, AP propellant (MUIDEN), and CIL lot 5554 from Canada.
- 2. Perform tests and evaluations at RAAP in screening ballistics parameters and developing "Americanized" propellants by means of closed bomb, chemical and physical tests, using specification MIL-P-3984 as a guide.
- 3. a. Based on the previously referenced work, RAAP was to manufacture, test, and deliver four 200 to 400-pound samples. Gun testing at RAAP was to be accomplished using FACC supplied: (1) single-shot test fixtures; (2) cartridge cases; (3) primer ignition systems; and (4) projectiles and gauges.
- b. Samples of four existing lots at RAAP were to be shipped immediately to FACC for evaluation.
- 4. A 1000-pound pilot lot was to be produced based on the data from the preceding work.
 - 5. Technical progress reports on a regular basis were required.
 - 6. Ballistic parameters to be measured were:

- a. Pressure versus time (from drilled cases) using Kistler transducers
 - b. Muzzle pressure versus time using Kistler transducers
 - c. Action time (primer strike to projectile exit)
 - d. Muzzle velocity measured at 20 to 40 feet from the gun muzzle



e. Barrel wear measurements were to be made on regular basis and reported in progress reports.

The importance of meeting flash requirements was discussed at that time but was not made a firm requirement. Also, the need to meet ballistic requirement at temperature extremes -54 to 71°C (-65 to 160°F) was discussed but no firm specification requirements were imposed on RAAP. No noise requirements were mentioned. However, it should be pointed out that the APCS-T specifications changed remarkably between 1978 and 1981 in the following respects:

| <u>Item</u> | Specification ADMS 567895 | Specification AS12013523B | <u>Effect</u> |
|--|---------------------------|----------------------------|-------------------------|
| Muzzle velocity correction factor, m/s/m (retardation) | 12.5 | 0.19 | -10 m/s at any pressure |
| Projectile weight, grams | 132 | Unspecified (possibly 135) | -6.6 m/s/g per gram |
| Test cartridge loading, grams | <u>+</u> 0.1 | <u>+</u> 1 | <u>+</u> 10 m/s |

RAAP Gun Test Facilities

Shortly after the project had been funded, it was determined that RAAP's Ballistic Range was inadequate for guns greater than 20 mm in size and that the following additional work scope was required:

Addition to deflection fence

Modification and addition to chain link security fence

Reinforced concrete foundation for gun mount

Reinforced concrete foundation for shed roofs

Reinforced concrate foundation for four velocity screens

Metal shielding for velocity screens

Shed roofs for gun mount

Shed roofs for four velocity screens

Adjustable mounts (metal) for four velocity screens

An electrical solenoid (firing mechanism)

Steel adapter plates for mounting 25-mm and 30-mm guns

Installation of electrical conduit, wiring, in connection with remote shell firing

Adaptations to utilize existing safety interlocks and firing circuits

Replacement of sand in tunnel

Application of steel plate on control house door

This extra effort required the authorization of a sum of money considerably greater than had been funded to the project, required more than a year for accomplishment, and resulted in RAAP's inability to accomplish gun testing for more than a year after the propellant was 2 the custome ' (range completed February Consequently, the Ballistic Range improvement effort and the propellant development effort became separate and parallel efforts. propellant development effort became dependent upon physical, chemical, and closed bomb testing performed at RAAP and gun testing performed at The old RAAP gun was used to test only lots RAD-PE-559-11 through 16 at 21°C (70°F) using the off-the-shelf threaded primers. RAAP gun system was used to test all subsequently produced lots.

FACC Evaluation of Existing RAAP Propellant for HEI-T and APDS-T Projectiles

Four samples of methyl centralite (MC) coated SP M10 propellant remaining at RAAP from 20-mm gun development support effort (Production FACC Engineering Project PE-485) were shipped to for evolutionary gun propellant and the 25-mm Mann gun test data are The gun test results presented in tables 1, 2, and 3, and in appendix B. from the most satisfactory of these sublots (B1) for the APDS-T projectile are compared in figures 1 and 2 with gun test results from the first coated MP lots for the same projectile. MC had become the coating of choice because the 20-mm program had found other coating materials, ethyl centralite (EC) and dibutyl phthalate (DBP), to yield carbonaceous matter in rapid firing guns.

The ballistic evaluations by FACC of the blended and unblended samples from the four sublots (Al, A2, B1, and B2) of SP propellant from PE Project 485 led to a request for 200 and 800-pound samples from the A and B sublot dies, respectively. Each was to have a specific percentage of MC coating. These samples were coated from existing uncoated inventory at RAAP. Chemical, physical, and closed bomb tests for these lots are presented in table 4. To maintain die sublot identity, the lots were designated to be lot PEI-559-1, S/L A3 and S/L B3.

he desired coating levels were obtained and PEI 559-1, A3 sublot (4.56% MC), proved to be a satisfactory propellant for the HEI-T projectile and the only SP HEI-T lot (KAD-PE-559-6) subsequently produced was made to duplicate the PEI 559-1, S/L A3 lot.

The final version of the manufacturing and coating procedure used for propellant for the HEI-T projectile is contained in appendix C.

All necessary preproduction engineering work on deterred SP propellant for the HEI-T project was completed with the delivery and acceptance of pilot lot RAD-PE-559-1, S/L A3 and first production lot RAD-PE-559-6. The production lot is being used by FACC as the reference lot for future propellant procurement for a 25-ma gun system that is interchangeable among the forces of all NATO nations. The closed bomb traces in figure 3 show how the RAAP lots relate to each other, the original reference lot, and uncoated blank stock with regard to Dp/Dt versus pressure.

The propell

All for the pilot of the pilot Based on acceptance gun tests at FACC, MC deterred MP M10 propellant developed for the APDS-T projectile was acceptable through the pilot lot (RAD-PE-559-11) phase and through two production lots (RAD-PE-559-15 and 16) before any unacceptable variables (pressure level) or attributes These problems were later studied or (flash and noise) were reported. directed by the Contracting Officer's Representative. resolved as Therefore, the production engineering effort described hereinafter which led to these lots will be only partially applicable to the propellant finally developed for this projectile. However, this report indicates the reasons why the propellant produced at the conclusion of this project required further tailoring during subsequent production efforts. also disclose some probable ways the propellant can be further improved. Although, as pointed out earlier, the final APDS-T propellant ballistic specifications differed remarkably from the earlier specifications and required a considerably improved coated propellant product over that originally required.

RAAP Laboratory and Closed Bomb Studies

Studies of potential single-perforated and multi-perforated foreign and CONUS reference propellants were performed concurrently with efforts previously described. Canadian and Swiss coated propellant lot samples provided by FACC, propellant samples coated at RAAP for previous PE Projects 271 and 485, and base grain propellant samples from PE Project 485 coated with other coating materials were subjected to chemical, physical, closed bomb, and heat of explosion (HOE) tests. are shown in table 5. Based on the fact that lot CIL 5554 was being used to replace either lot P-2078 or P-1929, any of the propellant samples, except the ones coated with ethylene dimethacrylate (EDM) (possibly inadequately) or lead 2-ethyl hexoate, may have qualified as replacement Closed bomb Dp/Dt versus P traces for G54 coated RAD-PE-485A SP

propellant were those from lot P-2078, the original single-base MP Oerlikon lot, as shown in figure 4.

لمارعة منارعها مناملاهما والمنطوخ والمنافذة والمنطوع والمناورة والمداورين والمنازون والمنطوعين والمنطوب

Although the G54 coatings on double- and triple-base formulas have proven satisfactory for 25-mm and 30-mm guns, the Contractor was directed to produce 7-perf single-base propellant coated with MC because: (1) G54 coatings "left residue in gun barrels," (2) "more loadability of propellant was needed to effect minimum momentum for the AP-T projectile," and (3) "dinitrotoluene (DNT) coatings were corrosive to gun barrels." The laboratory studies were therefore discontinued.

MC Coated 7-Perforation Single-Base Propellant for the APDS-T Projectile

A study using a projected L/D ratio of 1.0 (a 2 by 2 factorial study of MC coating levels and web sizes) was performed to determine the geometry and coating to be used for future lots. The lots were produced using dies available at RAAP which resulted in obtaining one lot of 7-perforated propellant with the same web (0.0187 in.) as the target lot (P-2078) and another with a smaller web (0.0157 in.), as intended.

A new coating procedure was developed. Pilot lots were being coated by RAAP's laboratories to determine by HOE and closed bomb testing the amount of coatings to be applied. A long-standing method (Old Method - see appendix D) of coating by steeping propellant and MC in water at 86°C (187°F) for 6 hours in a coating barrel required at least twice the amount of MC to obtain required HOE and closed bomb values than an alternate 1/2-hour coating cycle (New Method - see appendix E) developed and used at RAAP for another program. The results by both methods for sublots of lots RAD-PE-559-3 and 4 are contrasted in table 6.

These data clearly indicated that increased propellant loadability and any possibility of increased APDS-T projectile velocity required the use of the new coating method. The new coating method, with the exception that cycle time was increased from 1/2 to 2 hours commencing with lot RAD-PE-559-11, was used for all subsequent lots. Also, essentially the same MC coating (2.2%) as was predicted from this study for the RAD-PE-559-4 subject to duplicate the original reference lot (P-2078), was used for all subsequently produced acceptable lots for the APDS-T projectile. The dies used for the RAD-PE-559-4 sublots were used for all subsequent APDS-T propellant production except for one other investigation (which was unsuccessful). These dies produced exactly the same propellant web as that of the original reference let (P-2078).

The acceptance test data obtained for lots RAD-PE-559-3A, 3B, 4A, and 4B are presented in table 7. The FACC gun test data for lots RAD-PE-559-4A and 4B and blends of these lots are presented in table 8. These ballistics data are plotted against charge weight in figures 1 and 2 and are compared with the best of the SP MC coated lots (RAD-PE-485-B1) for the APDS-T projectile. The graphed data show that pressure levels

would be marginal with the lower projectile weights for SP MC coated propellant (RAD-PE-485-B1) or MP MC coated propellant using the 12.5 m/s/m extrapolation factor and 132-gram projectiles. Also, it was indicated from previous tests that blends of webs and coating levels did not sufficiently improve the velocity-pressure relationships (see figure 5 and 6) although specification conformance probabilities were greater using the old rather that the new velocity correction factor.

In all cases studied with both the SP and MP propellants used for the APDS-T projectile, the MC coating level was a very dominant factor in determining velocity-pressure-charge weight relationship. Therefore, it was indicated that the MC coating level for future lots be accurately ascertained. The next two series of lots RAD-PE-559-5A through 5E and 7 and 8 were essentially produced to establish this level. In the process it was learned that a different mode of post coating drying would be required and that longer coating cycle times (45 and 120 minutes) were beneficial.

APDS-T Coating Studies

In order to determine the proper MC coating level, approximately 2000 pounds of propellant were produced using the established die configuration and manufacturing procedure. Seven pilot lots, each with a specified coating level and identified as lots RAD-PE-559-5A, 5B, 5C, 5D, 5E, 7, and 8, were produced from this common propellant batch and tested at FACC. The FACC gun test results and the MC percentages (specified, used, and analyzed) to obtain these values are as follows:

| | Per | rcentage | FACC gun test resultsa | | | |
|--------|-----------|----------|------------------------|-----------|-----------|------------|
| Lot RA | Ù | MC | | Velocity, | Pressure, | Charge wt, |
| PE-559 | Specified | Used | Analyzed | m/s | MPa | <u>\$</u> |
| 5▲ | 2.70 | 2.55 | 2.53 | 1280 | 352 | 98 |
| 5B | 3.20 | 3.00 | 3.03 | 1250 | 303 | 98 |
| 5C | 3.70 | 3.49 | 3.51 | 1215 | 283 | 98 |
| 5D | 1.50 | 1.56 | 1.39 | 1300 | 448 | 90p |
| SE | 2.00 | 2.07 | 1.89 | 1320 | 386 | 98 |
| 7 | 2.00¢ | 2.10 | 1.97 | 1322 | 386 | 98 |
| 8 | 2.35c | 2.08 | 2.10 | 1317 | 465 | 96b |

a 132-gram projectiles were used in all cases.

Pressures were reportedly too high to test greater charge weights.

These two batches were to have the same coating level as lot RAD-PE-559-5E which had previously been produced and tested.

It will be observed from the preceding data that two of the pilot lots, RAD-PE-559-5D and 8, were found to yield unacceptably high pressures. This high pressure for lot RAD-PE-559-5D could logically be attributed to the low quickness (RQ) result. However, lot RAD-PE-559-8 was found to yield relatively high quickness and gun pressure results for no measurable reason unless these could be explained by coating time, the only observed difference which had inadvertently been somewhat longer for lot RAD-PE-559-7 than for lot RAD-PE-559-8. For all of the lots it was found to be impossible to remove alcohol acquired in the coating operation by forced air drying at 60°C (140°F).

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Alcohol removal from subsequently produced lots was effected to less than one-half of a percent by drying coated stock for 48 hours in a water dry. The results from lots RAD-PE-559-5A through E and 7 and 8 are presented in table 9.

The MC coating levels for lots RAD-PE-559-5A, 5B, 5C, 5E, and 7 versus FACC measured gun pressures and velocities at 98-gram charge weights and with 132-gram projectiles are shown in figure 7. The RQ at $+32.2^{\circ}$ C ($+90^{\circ}$ F) versus gun variables for these lots is presented in figure 8. The data indicated that a more energetic propellant with a greater coating may be required.

Subsequent lots were produced having potassium sulfate decreased from 1.0 to 0.5%, alcohol eliminated by water drying, ether eliminated by the coating operation, and with relatively higher MC coating levels. The ether level reduction (>1%) during coating is greater than could be accomplished in 20 000 hours of water drying at 50° C.

On 17 August 1977, the gun test facilities at RAAP were available for testing. However, testing was further delayed because the projectiles had a 0.995-inch diameter while the gun had a 0.987-inch internal diameter. The projectile diameters had to be machined to be within tolerances of 132-gram SP propellant projectile weights.

Lot RAD-PE-559-7, which was to duplicate lot RAD-PE-559-5E, was reported to be a satisfactory lot by FACC. Four 1000-pound pilot lots were ordered for a 2 by 2 factorial length and MC coating level study. Propellant with a greater impetus level was desired. Hence, the decreased potassium sulfate level (0.5%), a longer coating time (120 minutes) to further remove ether and improve coating gradient, 28 to 48 hour water dry time to remove practically all of the coating acquired alcohol, and a nitrocellulose nitrogen content as close as possible to 13.20% were specified. The specifications for these lots are in appendix A-4 (COR letter, SARRA-EN dated 10 November 1977). The MC coatings specified, used, and obtained with specified L/D ratios and ballistic results follow:

RAAP gun tests with 98-g charges

| Lot RAD- | MC Coating, % | | | L/D | Pressure, | Velocity, | |
|----------|---------------|------|----------|-------|-----------|-----------|--|
| PE-559- | Specified | Used | Analyzed | Ratio | MPa | m/s | |
| 11 | 2.25 | 3.17 | 1.92 | 1.1 | 383 | 1321 | |
| 12 | 2.75 | 3.90 | 2.37 | 1.1 | 349 | 1283 | |
| 13 | 2.25 | 3.12 | 1.84 | 1.3 | 392 | 1327 | |
| 14 | 2.75 | 4.05 | 2.26 | 1.3 | 3.56 | 1313 | |
| 5E | 2.00 | 2.07 | 1.89 | 1.1 | 386* | 1326* | |
| 7 | 2.00 | 2.10 | 1.97 | 1.1 | 386* | 1326* | |

*Reference lots with test made at FACC. A 2 m/s/m velocity correction was made in all cases.

Pilot mixes were coated and evaluated from each of the lots before the lots per se were coated. The pressure-velocity-charge weight data in figures 9 and 10 from preliminary and limited RAAP tests showed lot RAD-PE-559-11 to be the most acceptable lot. The FACC gun tests showed lot RAD-PE-559-11 to be acceptable and it was used as the model lot for succeeding production lots RAD-PE-559-15 and 16. These three lots are compared in figures 11 and 12 with the original Swiss reference lot P-2078.

The old specification (ADMS 567895) in effect for all of development work, which required 1.25 m/s/m velocity-corrections and 132-gram projectile weights, was not too difficult to meet. specification AS12013532 which does not limit projectile weight (FACC apparently used 135 grams) and with changed velocity correction to 0.19 m/s/m is remarkably more difficult to meet (because propellant tailoring for a 30 m/s higher velocity at any pressure is required), and could require the development of a new propellant.

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The velocity-pressure-charge weight relationships for model RAD-PE-559-11 and production lots RAD-PE-559-15 and 16 are shown in The effect of the change in specified velocity figures 11 and 12. correction factor from 1.25 to 0.19 m/s is shown in the velocity charge relationships in figure 11. The effects of the specification changes in correction factor and projectile weight on required specifications and gun propellant pressures significant.

Subsequent to the time that lot RAD-PE-559-11 was produced, no significant changes were made in the manufacturing or coating processes, that improved coating equipment was installed after RAD-PE-559-23 was produced. Therefore, the process and coating changes and their effects were the same up to the time of production of lot RAD-PE-559-15 and 16. Engineering effort normally ceases with the

delivery of the first production lot. However, in this case it was continued through the second production lot which was accepted on 2 February 1979.

In August 1980, it was learned that flash and noise problems had been encountered in the field at Fort Carson, Colorado, and that 1/2 gram (1/2%) of potassium nitrate salt was being added to charges from lot RAD-PE-559-16. Another lot, RAD-PE-559-17, with potassium sulfate increased from 0.50 to 1.00%, was ordered and delivered in October 1980. At this time it was learned that an excessive gun pressure problem also existed. It was indicated that the increased salt may have been the assignable cause. Also, some questions of lack of uniformity of propellant arose. Because the PE program should have been concluded with lot RAD-PE-559-16, the production process and product quality at that time will be discussed before dealing with the subsequent problems. The chemical, physical, and closed bomb test results for the model and three subsequent production lots are shown in table 10.

State of the Art at Completion of PE Effort

The state of the art at the time that RAD-PE-559-17 was produced was such that a HOE range of 10 cal/g was observed among the four lots (one model and three production lots). This compares favorably with a 13 cal/g range for a series of solventless formula (N5) rocket propellant carpet roll lots. The reason for this excellent uniformity in energy content is that volatile solvents were virtually eliminated as variables. The coating mode and cycle reduces ether (by more than 1%) to an insignificant variable. The 48-hour post costing water dry cycle does the same for alcohol (reduces by more than 1%). Therefore, more energy is available after coating for projectile propulsion.

The amount of MC applied to propellant during the coating cycle is remarkably dependent upon time, as illustrated in table 10 and figure 13. The time involved in a coating cycle includes the 15-minute time on temperature at 24° C (75°F) when the MC slurry is added to the propellant with water and alcohol and extends through the time when the batch is immediately cooled to room temperature and washed with cold water.

Combined partial burner and chemical analyses have proven that MC applied to obtain coating percentages between 1.26 and 2.77 appear in propellant strata in fairly constant percentages of the total amount applied for a given geometry. The following table illustrates the percentage MC remaining after partial burns with blowout discs designed to cause approximately 1% per mil of disc thickness:

Grain weight percentages and MC coating percentages measured

| Partial burner | after partial burn tests for lots RAD-PE-559- | | | | | | | | |
|-----------------|---|-----|-----|-----|-----|------|-----|-----|--|
| disc thickness, | 20 | | 21 | | 22 | | 23 | | |
| mils | MC | Wt. | MC | Wt | ЙC | Wt | Mc | Wt | |
| Unburned | 100 | 130 | 100 | 100 | 100 | סר י | 100 | 100 | |
| 7 | 84 | 97 | 83 | 96 | 80 | 94 | 99 | 96 | |
| 25 | 29 | 61 | 32 | 61 | 22 | 62 | 26 | 66 | |
| 40 | 20 | 55 | 20 | 52 | 0 | 51 | 20 | 60 | |

Linear regression (Y = MX + b), slopes (M), intercept (b), and correlation coefficients (\mathbb{R}^2) for percent MC remaining (X) related to remaining weight percentage (Y) are in the following table:

| Lot RAD- PE-559- | Percent MC before partial burn | Ħ | <u>b</u> | Web, in. | Perf in. | <u>R</u> 2 |
|---------------------|--------------------------------------|--------|----------|----------|----------|------------|
| 20 | 1.97 | 0.5894 | 43.918 | 0.0184 | 0.0066 | 0.994 |
| 21 | 2.77 | 0.62 | 40.668 | 0.0181 | 0.0064 | 0.993 |
| 22 | 1.35 | 0.5058 | 51.205 | 0.0194 | 0.0058 | 0.997 |
| 23 | 2.39 | 0.4595 | 52.357 | 0.0195 | 0.0054 | 0.995 |

Therefore, different levels of MC appear to have the same distribution profile for a given perforation and web size. However, significant differences in total penetration and penetration quantity at a given depth result from very small differences in perforation and web sizes. A two-hour coating cycle was used for these lots.

As can be seen in table 10, dimensional and chemical analytical results for model lot RAD-PE-559-11 and production lots RAD-PE-559-15, 16, and 17 were nearly identical with the exception of increased potassium sulfate for lot RAD-PE-559-17. This is enhanced by the fact that HOE among lots varied not more than 10 cal/g which is the equivalent of a 0.5% total of any combination of alcohol, ether, and MC. Also, as can be seen from figure 14, lots RAD-PE-559-7, 11, 15, 16, 17 and Swiss lot P-2078 (original reference lot), closed bomb traces are congruent to the extent that these traces could have been from a single lot. RAD-PE-559-11 deviated in Dp/Dt on the upper side at pressures up to 83 MPa (12 000 psi) as though it had received less coating than the other The data show this to be true. Lot RAD-PE-559-7 coincides with the final lot and reference lot traces and it was not as ballistically acceptable as lots RAD-PE-559-15 and 16. However, one must reach the conclusion that the reference lot (P-2078)and production RAD-PE-559-15, 16, and 17 yielded remarkably similar closed bomb test All closed bomb tests were conducted in a 200 cm³ closed bomb at 32°C (90°F) using a loading density of 0.2 g/cm³.

Based on the preceding test data uniformity, it would be expected that there would be little difference in gun test data among these lots. The gun test data obtained at either FACC or RAAP for 98-gram charge weights from all lots known to have been acceptable to FACC were studied. These are presented in the following table:

| | 98-gram | charge | | | | |
|--------------------------|-----------|-----------|-----------|--|--|--|
| | Pressure, | Velocity, | Tested | | | |
| Lot RAD-PE-559- | MPa | m/s | <u>at</u> | Remarks | | |
| 5E | 386 | 1320ª | FACC | All tests were made | | |
| 7 | 393 | 1326ª | FACC | at 21°C. All lots | | |
| 11 | 379 | 1318ª | RAAP | contained 0.5% | | |
| 15 | 384 | 1342ª | RAAP | K ₂ SO ₄ . First two | | |
| 15 | 357b | 1332 | FACC | lots were coated for | | |
| 16 | 389 | 1348ª | RAAP | 30 and 45 minutes, | | |
| 16 | 389 | 1332 | FACC | respectively, while | | |
| P-2078 (Swiss reference) | 382 | 1334ª | RAAP | lot 11 had a 24-hour post coating water | | |
| Average of averages | 386 | 1331.5 | | dry. All rounds corrected for +2 m/s/m | | |
| Std dev of averages | 4.76 | 10.24 | | to obtain muzzle velocity. | | |
| Indicated upper 3 limit | 400 | 1362 | | - | | |
| Indicated lower 3 limit | 372 | 1301 | | | | |

a Indicates it was known or reported that 132-gram projectiles were used.

From the preceding table it is obvious that both FACC and RAAP obtained relatively high pressures for all of the reference (or model) lots and the first two production lots. Also, the velocities at FACC were 10 to 15 m/s lower than those obtained at RAAP for the two comparable production lots. Therefore, 2 to 3 more grams of propellant (with 15 MPa or total of 401 MPa additional pressure) would be required by FACC to obtain specified velocity in cases designed to hold 98 grams (the capacity of reference lot P-2078) with propellant specified to have less loading density (0.92 g/cm³ minimum).

Only from lots RAD-PE-559-11, 12, 13, 14, 15, and 16 are comparable data available from the test gun originally supplied to RAAP and the tests made at FACC with other guns and ammunition.

b Value excluded statistically.

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SUBSEQUENT PRODUCTION ENGINEERING STUDIES

As requested, RAAP produced a 5000-pound lot (RAD-PE-559-17) with potassium sulfate changed from 0.5% to 1.0% even though indications were that 0.5 gram of potassium nitrate added to cartridges containing lot RAD-PE-559-16 was the assignable cause for higher gun pressures. The lot was produced, shipped, and gun tested only at FACC. The lot was found to yield high gun pressures at FACC although the only chemical, physical, or closed bomb difference between this lot and lot RAD-PE-559-15 (the reference lot) that could be found was the expected difference in potassium sulfate level (as previously pointed out in table 10 and figure 14).

Again as requested, a 500-pound batch from this lot was modified and shipped to FACC where the testing of the lot was witnessed by Hercules and Government representatives. The following results were obtained for this modified batch RAD-PE-559-17B or RAD-PE-559-17M on 4 and 5 October 1980.

| Work dir | Velocity,m/s | Average pressure, MPa | No. rounds | Propellant charge weight, gram | Test temp, o <u>C</u> | Piezo gauge |
|----------|--------------|-----------------------|---------------|--------------------------------------|-----------------------------|----------------|
| ATP 1306 | 1342 | 418 | 10 | 99 | 21 | PCB 1728 |
| ATP 1307 | 1346 | 446 | 25 | 99 | 21 | PCB 1761 |
| ATP 1307 | 1346 | 401 | 21 | 99 | 21 | PCB 1763 |
| ATP 1307 | 1344 | 407 | 5 | 99 | 21 | PCB 1764 |

Gauge number PCB 1761 was changed at the writer's request and pressures were lowered by 39 to 45 MPa on succeeding series of tests. This difference was considered to be significant in results associated with gauges. However, the gauge (PCB 1761) was tested by FACC personnel and found to be acceptable.

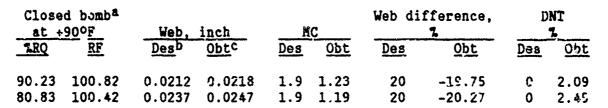
Additional Pilot Lots

Also ordered at the same time as lot RAD-PE-559-17 were two small pilot lots (RAD-PE-559-18 and 19) with larger wers (0.22 and 0.24 inch). The L/D and D/d rates were unspecified except in the specification drawing. The specification drawing requirements for these ratios were used rather than those desired but inadvertently never specified.

These lots (see attached description sheets in appendix F) with the larger webs were produced and coated. However, the lots became contaminated with DNT from hidden recesses of the barrel from a previous coating operation. This was discovered only during the analysis of the lots by a gas chromatographic method used to determine volatiles and moisture.

As would have been expected, the DNT coated the propellant first and limited the amount of MC that could be subsequently applied. The percentage of the two coatings obtained and the amount of MC desired follow:

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- Results are for lot RAD-PE-559-18 and 19, respectively. Lot RAD-PE-559-1' was used as reference lot.
- b Des is desired
- c Obt is obtained

It will be noted that although the RQ was high and the total coating was high by at least 1%, the force was 100% or higher.

The closed bomb traces for these lots were different from any other lot produced in the Bushmaster series. The Dp/Dt versus P traces between pressures of 41 and 83 MPs (10 000 and 20 000 psi) were remarkably better in slopes and intercepts than those obtained from any of the other lots. These traces are shown in figures 15 and 16. The gun test results obtained from the product of this coating process (see appendix 6) were also unique and favorable as would have been predicted from the closed bomb results.

As directed, several other lots and blends of lots (RAD-PE-559-24 through 30) were produced. These efforts are summarized in appendix G. It is remarkable that each test of each lot or blended batch produces an entirely different result. Perhaps this is, as observed earlierentirely the result of gauge bias.

The following results have been reported for lot RAD-PE-559-16 at 21°C:

| 787, eq | No. rounds | Pressures, | Velocity, | Cherge wt. |
|---------|---------------|------------|-------------|------------|
| 17.5 | 20 | 370 & 384 | 1334 & 1342 | 99.7 |
| No | 20 | 372 & 362 | 1336 & 1360 | 92.7 |
| No | 20 | 378 | 1348 & 1360 | 99.7 |
| Yes | 40 | £32 | 1350 | 99.7 |
| Tes | 20 | 424 G 422 | 1350 | 99.7 |
| Yes | 20 | 402 | 1325 | 99.5 |
| Average | unsalted | 573 | 1345 | |
| Average | salted | 420 | | |



It appears that the addition of 0.5% of potassium nitrate did increase pressures by 47 MPa without affecting velocity, assuming no gauge or other component bias.

The APDS-T propellant and coating process developed up to the changes in projectile weight, velocity correction factor, and propellant formula change to increased potassium sulfate are contained in appendix H. All description sheets obtained for this project are shown in appendix F.

CONCLUSIONS

- A completely acceptable, MC-coated SP propellant was developed for 25-mm HEI-T Projectile. The acceptable reference lot RAD-PE-559-6(HE) and the description sheet for this lot is attached in appendix F.
- A study of coating materials for the APDS-T projectile using SP M10 propellant disclosed that Paraplex G54 and EC, in single or double coatings or with DBP, were as effective as MC coatings.
- 3. A unique production and coating process using alcohol, water, and KC was established for MP M10 propellant such that the Swiss reference lot performance was equaled or bettered. It would not have been possible to produce satisfactory propellant with the previous MC coating process.
- The two-stage application of DNT and MC effected improved Dp/Dt versus P relationships.
- The most acceptable APDS-T lots studied by closed bomb tests during this project were ranked in order of acceptability as follows:

| | <u>Lot</u> | Remarks |
|-----|---------------|---|
| 1. | CAD 5554 | MC coated Canadian w/erganic lead salts |
| 2. | CIL 3331 | MC coated Canadian w/organic lead salts |
| 3. | P-1929 | Oerlikon camphor coated SP |
| 4. | RAD-PE-559-18 | MC and DNT coated |
| 5. | RAD-PE-559-19 | MC and DNT coated |
| 6. | HRS-7 | German EC-DRP coated |
| 7. | RAD-PE-559-21 | MC coated MP M10 |
| 8. | RAD-PE-559-16 | MC coated MP M10 |
| 9. | RAD-PE-559-17 | MC coated MP M10 |
| 10. | RAD-PE-559-7 | MC coated MP H10 |
| 11. | RAD-PE-559-15 | MC coated MP M10 |
| | RAD-PE-559-23 | MC coated MP M10 |
| | P-2078 | Camphor cost Oerlikon ref |
| | RAD-PE-559-11 | MC coared MP H10 |

RECOMMENDATIONS

- 1. Longer coating times, varied alcohol to water ratios, and different coating cycles should be evaluated to determine whether the 25-mm APDS-T propellant can be improved.
- 2. The DNT and MC coating process discovered during this project should be further evaluated to determine whether it can be used to produce improved coated MP M10 propellant.
- 3. Other coatingr, particularly Paraplex G54, should be evaluated with SP M10 propellant to determine whether an improved APDS-T propellant can be produced.
- 4. The pressure gauge uniformity problem should be thoroughly studied. If, for example, gauges with low sensitivities do give high pressures such as those observed on 14 and 15 October 1980, then specification limits should be set on gauge sensitivities or correction to some standard conditions should be made for each gauge.
- 5. The study of M10 formula propellant with basic lead carbonate or other lead salts is highly recommended.

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Table 1. Chemical and physical data for sublots of single-base, single-perforated propellant for 20-mm gun

| | PE Pro | ject 485 | Sublot nu | mber |
|---------------------------------|--------|----------------|-----------|--------|
| <u>Item</u> | S/L A1 | <u> S/L A2</u> | 3/L B1 | S/L B2 |
| Nitrocellulose, % (13.15%N) | 94.25 | 92.48 | 94.82 | 92.82 |
| Diphenylamine, % | 0.55 | 0.57 | 0.52 | 0.51 |
| Potassium sulfate, % | 0.79 | 0.85 | 0.79 | 0.76 |
| Methyl centralite, % | 4.26 | 5.95 | 3.74 | 5.80 |
| Graphite, % | 0.11 | 0 15 | 0.13 | 0.11 |
| Six-hour M&V, % | 0.44 | 0.63 | 0.62 | 0.75 |
| Bulk density, g/cm ³ | 0.9892 | 0.9805 | 0.9933 | 0.9985 |
| Physical dimensions: | | | | |
| Mean length, in. | 0.067 | | 0.067 | |
| Mean outside diameter, in. | 0.052 | | 0.055 | |
| Mean perforation, in. | 0.0043 | | 0.0042 | |
| Mean web. in. | 0.0235 | | 0.0257 | |



Table 2. FACC gun tests of PE-485 sublots of MC-coated M10 single-perforated propellant from 20-mm program with 177-gram HEI-T projectile

| Round | Prop sublots | Chg wt, | TA, Milli- second | | Pc, MPa | Vm,* m/s | Remarks |
|-------|-----------------|---------|-------------------------|------|------------|-------------|------------------------------------|
| 1 | PE-485-A1 | 75 | 5.62 | 29.4 | 336.5 | 1030 | 485B sublots too |
| 2 | PE-485-A2 | 75 | 6.21 | 33.2 | 231.7 | 941 | fast for RE and were used w/AP. |
| 3 | PE-485-B1 | 75 | 5.26 | 26.8 | 395.1 | 1038 | There are indi- cations that a |
| 4 | PE-485-B2 | 75 | 6.68 | 30.4 | 197.2 | 899 | 10-gram heavier projectile is con- |
| 5 | Al | 80 | 6.43 | 30.8 | 318.6 | 1076 | templated for future use. |
| 6 | A2 | 85 | 6.27 | 37.9 | 233.8 | 1012 | Spec? |
| 7 | Al | 90 | 5.04 | 30.7 | 431.7 | 1172 | Shell cap = |
| 8 | A2 | 90 | 5.75 | 37.0 | 277.2 | 1068 | 90 g 1085 + 15 m/s |
| 9 | A1/A2 | 80/10 | 5.2 | 31.3 | 416.5 | 1170 | w/390 MPa max press |
| 10 | A1/A2 | 85/0 | 5.45 | 39.3 | 357.2 | 1118 | |
| 11 | A1/A2 | 70/20 | 5.2 | 32.1 | 396.5 | 1154 | |
| 12 | A1/A2 | 65/25 | 5.41 | 31.8 | 390.3 | 1152 | |
| 13 | A1/A2 | 60/30 | 5.45 | 35.2 | 365.5 | 1148 | |
| 14 | Al/A2 | 50/40 | 5.07 | | 382.0 | 1128 | |
| | | | | | | | |



^{*}Desired or greater velocities are underlined along with corresponding acceptable pressures. The velocities probably are corrected by twelve rather than two u/s/m.

Table 3. FACC gun tests of PE-485 sublots of MC-coated, M10 single-perforated propellant from 20-mm program with 121.5-gram A-T projectile

| Round | Prop. sublots | Chg wt, | TA, ms | Pm, MPa | Pc, <u>MPa</u> | Vm,* m/s | Remarks |
|-------|---------------|---------|-----------|------------|-------------------|-------------|--|
| 1 | Al | 75 | 5.25 | 27.7 | 278.6 | 1091 | Specs |
| 2 | A2 | 75 | 6.03 | 27.0 | 181.4 | 971 | 1372 <u>+</u> 15 m/s 390.2 MPa, max |
| 3 | B1 | 75 | 5.37 | 27.7 | 291.7 | 1280 | 100 g case capacity. Data |
| 4 | В2 | 75 | 6.35 | 25.6 | 152.4 | 923 | indicate that FACC test slug |
| 5 | B1 | 89 | | 28.5 | 209.0 | 1081 | |
| 6 | B1 | 85 | 5.71 | 31.2 | 255.8 | 1177 | |
| 7 | B1 | 90 | 5.49 | 33.7 | 297.2 | 1203 | |
| 8 | B1 | 95 | 5.31 | 35.7 | 339.3 | 1293 | |
| 9 | B1 - | 97 | 5.07 | 37.0 | 359.3 | 1322 | |
| 10 | B1 | 98 | 5.19 | 37.7 | 368.2 | 1328 | |
| 11 | Bl | 100 | 4.91 | 37.0 | 402.0 | <u>1361</u> | |
| 12 | B1/A1 | 75/25 | 4.47 | | 404.8 | 1349 | |
| 13 | B1/A2 | 75/25 | 4.57 | | 369.6 | 1322 | |
| 14 | B1/A2 | 85/15 | 4.56 | | 393.1 | 1332 | |

^{*}Desired or greater velocities are underlined along with corresponding acceptable pressures. The velocities probably are corrected by twelve rather than two m/s/m.

Table 4. Acceptance test results for 25-mm lots 559-1, A3 ar. 1 B3

| Constituent | Specification a | Lot PE | I-559-1 A3) | | I-559-1 B3) |
|---|------------------------------|---------------------|----------------|----------|---------------------|
| Nitrocellulose,% (13.12%N) | Remainder | 92.3 | L4 | 92. | 51 |
| Diphenylamine, % | 0.50 to 1.25 | 0.6 | 52 | 0. | 67 |
| Graphite, % | 0.40, max | 0.3 | | | 14 |
| Methyl centralite, % | In parenthesis | 4.5 | 56 | | 88 |
| D-+ | 0.10 - 1.0 | 0 (| | | , nom) |
| Potassium sulfate, % Total volatiles, % | 0.10 to 1.0 2.35, max | 0.8 | | | 89 |
| M&V, % | 1.00 + 0.25 | 1.1 | | | 91 18 |
| Residual solvents, % | 1.10, max | 0.6 | | | 73 |
| noolease solvenes, n | 1.10, man | 0.0 | ,, | 0. | 7.5 |
| HOE, cal/g | N/A | 846. | L | 862. | 7 |
| Expected charge from | (121.5) ^a | 102 | | 100 | |
| HOE for AP-T, g | | | | | |
| Expected charge from HOE for HE, g | (177) ^a | 92 | | 90 | |
| Dimensions, inch | | | | | |
| Length | | 0.0 | 071 | 0. | 070 |
| Diameter | | | 0527 | | 0556 |
| Perf diameter | | | 0053 | | 0056 |
| Web | | 0.0 | 0236 | 0.0251 | |
| Stability, methyl viole | t tost | | | | |
| Heat test, 134.5°C, | 40, minimum | 50 | | 50 | |
| minutes | , a management | • | | 50 | |
| No explosion, hours | 5, minimum | 5+ | | 5+ | |
| | 3b | | | , | ્વ |
| Closed bomb test, 200 c | m bomb | Load | ding den | sity, g/ | CIE O |
| Relative quickness, | -57°F | $\frac{0.1}{92.51}$ | 0.2 | _0.T | $\frac{0.2}{83.92}$ |
| percent average | +90°F | 117.29 | 106.31 | 109,45 | 99.67 |
| bereene average | +165°F | 135.32 | 123.42 | 128.68 | 113.59 |
| | - 100 1 | | 167 · 76 | 120.00 | 113.00 |
| Relative force, | -57°F | 100.29 | 99.02 | 99.79 | 99.26 |
| percent average | +90°F | 101.80 | 100.81 | 101.44 | 99.67 |
| | +165°F | 102.65 | 102.85 | 102.48 | 101.92 |

a
b Projectile weights and specification at start of program.

PAD-PE-271-1 tested at 90°F was used as the standard because it more closely approximated CAD 5554 (depleted) in RQ and RF.



Summary or available test data for 25-um Bushmaster lots Tuble 5.

| | | | | | | Lot or Sa | Lot or Sample Identity | ty | | | | |
|----------------------------|---------------------------------|----------------------|----------------------|-------------------|----------------------|-------------------|------------------------|-----------------|-----------------|-------------------|-----------------------------------|---------------------------|
| | | | | | PE-485 | | | | RAD PE-485. | A Lots with | RAD PE-485A Lots with Coatings of | |
| Ingredient or Attribute | CAD 5554 | P1929 | P2078 | 118-7 | A1 6 A2 (2:1) | RAD 44378 | 271-5 | EC (2C) a | q(38)3a | C54 C | EDMd | L-26 ^e |
| Mirrocellulose. I | 97.71 | 98.40 | 97.94 | 98.44 | 98.56 | 98.61 | 98.24 | 98.56 | 98.36 | 98.56 | 59.56 | 98.56 |
| Dichenylamine. X | 0.87 | 1.07 | 1.03 | 0.85 | 0.59 | 0.68 | 0.87 | 0.59 | 0.59 | 0.59 | 0.59 | 0.59 |
| K.306. X | 9.62 | : : | 1.03 | ; | 0.85 | 6.71 | 1 | 0.85 | 0.85 | 0.95 | 0.05 | 0.85 |
| PECO1. | 0.60 | : | : | ! | - | 1 | ; | : | 1 | ! | ; | ! |
| Na 20 20 . X | ; | 0.53 | : | 0.71 | 1 | 1 | 68.0 | : | 1 1 | 1 | | 1 |
| TOTAL | 100.00 | 100.00 | 100,00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | | 100.00 |
| Coating, I | 4.828 | 6. non | 3.00 | 2.84 | 4.828 | 3.898 | 2.10t | 4.42 | 5.24b | 4.56. | 4.564.3 | 0.674.1 |
| * (**) | 41.0 | 0,00 | 91 | 1.70 | | ž | 2.20 | | | | 1 | |
| Craphice, A | 9.70 | 07.0 | 2: | | | | ?; | | | | | |
| Holsture, X | 1.23 | 0.89 | 1.15 | 6.70 | 1.19 | 1.20 | 7.0 | 0.22 | 0.21 | 67.0 | 0.72 | |
| Alcohol, Z | 0.00 | e | 7.0 | 0.86 | | | 3; | 0.11 | | | * o | |
| Ether, X | 0.37 | ļ : | 0.24 | 0.05 | | 0.74 | 0.65 | 0.74 | | | 20.0 | 1 |
| ¥. × | 1.60 | 1.27 | 1.86 | 1.67 | | 1.95 | 1.72 | 1.07 | | | .93 | |
| Residual Solvent, X | 0.37 | 0.38 | 0.71 | 0.88 | 27 | 0.75 | 0.65 | 0.65 | | | 0.71 | 1 |
| Configuration | SP | 2 | 皇 | ş | | SP | er er | as | | | Sp | |
| Wab, in. | 0.0244 | 0.019 | 0.019 | 0.021 | | 0.0271 | 0.023 | 0.0235 | | | 0.023\$ | |
| 00, tn. | 0.0553 | 0.S4 | 0.097 | 0.053 | | 0.0601 | 0.080 | 0.052 | | | 0.025 | 0.052 |
| 1D, In. | 9900.0 | 90.0 | 0.00 | 0.011 | | 0.0063 | 0.00 | 0.0043 | | | 0.0043 | |
| Length, in. | 0.0822 | 0.063 | 0.148 | 0.02 | 2.067 | 0.0734 | 0.054 | 0.067 | 0.067 | 0.067 | 0.067 | 0.057 |
| 140E, cal/g | | | | | | | | | | | | |
| Basic Formula | 984 | 166 | 987 | 1005 | 893 | 1003 | 984 | 1005 | 1005 | 1005 | 1005 | 1005 |
| Computed w/Coating | | 808 | 879 | 198 | 871 | 887 | 854 | 879 | 861 | 1 | ; | 978 |
| Hasured | | 800 | 928 | 847 | 840 | 856 | 839 | 832 | 838 | 865 | 898 | 926 |
| .061 | | ve Lot CAD 5554 | - | - | i of : | | | | | | | |
| 7 0.1 g/cm, X | 901 | 97.04 | 103.95 | 100.52 | 99.78 | 100.35 | 99.42 | 120.51 | 101.24 | 102.41 | 104.77 | 105.6 |
| K/Cm, | 100 | 99.76 | ž | | 100.96 | 100.63 | 99.82 | 101.19 | 101.57 | 102.41 | 104.20 | 105.4 |
| Closed | Bomb Average RQ vs Lot CAD 5554 | Lot CAD 555 | 4 | _ | i of: | - | _ | | | | | |
| | 2 | 85.93 | 111.72 | 106.56 | 89.40 | 91.90 | 86.74 | 96.42 | 96.48 | 98.13 | 127.18 | 144.8 |
| 0.2 g/cm', z | 100 | 97.6 | 115.31 | 111.26 | 96.25 | 97.26 | 99.27 | 103.97 | 102.12 | 108.47 | 120.6 | 140.3 |
| | | | | | | | | | | | | |
| Propellant Produced | | | | | | | | | | | | |
| 3y: | Canada | Sulse | Swien | German | RAAP | RAAP | RAAP | RAAP | RAKP | RAAP | KAAP | KAAP |
| Remarks: | Interio | Original Standard | Original Standard | 2-Step Ccating | 2:1 Blend of Al 6 | Blend of 'Coating | 2-Step Coating | 1-Step Ethyl | 1-Step Ethyl | 1-Step Polymer | 1-Step Polymer | 1-Step Lead 2-Prhyl |
| | | | | | ing Levels | | | Conting | | | | Hexoate |
| | | | | | | • | | | | | | |

VC(2C) - Ethyl Centralite (2-Stage Coating).

EC(SC) - Ethyl Centralite (Single Stage Coating).

EC(SC) - Ethyl Centralite (Single Stage Coating).

GS. - Paraplex Polymer (Thermometring).

EXM - Ethylene Dimmethacrylate Coating. Thermometring). Material was "old" in shelf life age and sat up too quickly during application.

EXM - Ethylene Dimmethacrylate Coating. Fromoted low pressure rates in coating much as if within propellant.

WC has been analyzed to be 13.73-13.27%; whereas, all other mamples were of 13.15% level.

Mathyl Centralite.

Gamphor.

Percent added per "as received" propellant weight.

Table 6. HOE, dimensional and closed bomb data; a contrast between old and new coating methods

Grain measurement, inch

Lot P-2078

| | WS f AP-T, 25-mm | Lot RAD-PE-559-4 | Lot RAD-PE-559-3 |
|-------------|------------------|------------------|------------------|
| Length | 0.1585 | 0.1249 | 0.1131 |
| OD | 0.0944 | 0.0975 | 0.0871 |
| Perforated | 0.0068 | 0.0078 | 0.0082 |
| Outer Web | 0.0161 | 0.0192 | 0.0172 |
| Inner Web | 0.0209 | 0.0182 | 0.0143 |
| Average Web | 0.0185 | 0.0187 | 0.0157 |

Old method of coating, HOE, and closed bomb data*

| | Lot P-2078 3% camphor | Lot RAD- % methyl 2.60 | PE-559-4 centralite 4.43 | | -PE-559-3 centralite 3.88 |
|-----------------------------|-----------------------|------------------------------|--------------------------------|---------------|---------------------------------|
| +90°F RQ, % +90°F RF, % | 100 100 | 115.2 | 104.7 | 126.6 | 117.3 |
| HOE, cal/g | 928.2 | 99.4 894.4 | 96.9 833.8 | 99.9 889.9 | 98.8 - 840.6 |
| Estimated MC of for 100% RC | | 5.2 | | 6.4 | |
| Estimated RF f | or 100% | 96 | | 97 | |

New method of coating, HOE, and closed bomb data*

| | Lot P-2078 | | | Lot RAD-PE-559-3 % methyl centralite | |
|-------------------------------|------------|-------|-------|--------------------------------------|-------|
| | 3% camphor | 3.91 | 5.72 | 2.46 | 3.88 |
| +90°F RQ, % | 100 | 94.08 | 87.72 | 105.29 | 93.02 |
| +90°F RF, % | 100 | 96.29 | 95.23 | 99.25 | 98.87 |
| HOE, cal/g | 928.2 | 843 | 816 | 896 | 854 |
| Estimated MC co | _ | 2.2 | | 3.1 | |
| Estimated RF for RQ level coa | | 97 | | 99 | |

^{*}Tests were made at $+90^{\circ}$ F, 0.2 g/cm³ loading densities in 200 cm³ closed bomb using lot P-2078 as standard.

| lots |
|------------|
| reference |
| with |
| lots |
| RAD-PE-559 |
| of |
| omparison |
| Com |
| 7. |
| Table |

| RAD-PE- 559-4B | 98.12 0.83 1.05 100.00 | 3.88 0.25 0.29 0.50 0.39 0.975 854 1.18 0.89 | 4A & 4B 0.1249 0.0975 0.0078 0.0187 5.62 1.28 | 97.34 98.87 |
|-------------------------|--|--|--|--|
| RAD-PE- 559-4A | 98.17 0.84 0.99 100.00 | 2.46 0.14 0.62 0.50 0.42 0.981 896 1.54 0.92 | 4A 0.0 0.0 0.0 1.2 1.2 | 99.75 |
| CAD 5554 | 97.71 0.87 0.62 0.80 | 4.82 0.16 11.23 0.00 0.37 0.962 846 1.60 0.69 | 0.0822 0.0553 0.0066 0.0244 SP 1.49 8.38 | 96.2 95.79 |
| Swiss P-1929 | 98.40 1.07 0.53 100.00 | 6.00 0.20 0.89 0.38 0.995 800 1.27 0.38 | 0.063 0.044 0.006 0.019 SP 1.43 7.33 | 93.40 |
| RAD-PE- 559-3B | 98.21 0.86 0.93 100.00 | 5.72 0.10 0.49 0.37 0.43 0.914 816 1.29 0.80 | 3A & 3B 0.1131 0.0871 0.0082 0.0157 18.84 1.30 | loading densities of: 96.19 95.93 |
| RAD-PE- 559-3A | 98.07 0.88 1.05 100.00 | 3.91 0.16 1.48 0.56 0.40 0.941 843 2.44 0.96 | 3A 0 0 0 0 1 1 10 10 | at loading 96.19 96.29 |
| Swiss P-2078 | 97.94 1.03 1.03 100.00 | 3.00 0.10 1.15 0.47 0.24 1.021 928 1.86 0.71 | 0.1585 0.0944 0.0068 0.0185 -25.95 1.68 | RF vs P-2078 s 100.00 106.00 100.00 |
| Ingredient or attribute | Nitrocellulose, % Diphenylamine, % K2SO4, % PbCO3, % Na2C2O4, % TOTAL | Coating, % Graphite, % Moisture, % Alcohol, % Ether, % Grav density, g/cm HOE, cal/g TV, % Res sol, % M&V, % | Dimensions: Length, in. Outside dia, in. Perf dia, in. Web, av in. Web diff, % L:OD ratio OD:d ratio | +90°F cloged bomb avg 0.1 g/cm ₃ 0.15 g/cm ₃ 0.2 g/cm |

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| | 1 I | | | | HE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY | |
|-----------------|-------------------------|---|----------|----------------|--|--|
| | RAD-PE- 559-4B | 88.38 93.02 | 0.03 | 98.00 | 60 + 5+ 1.38 | |
| | RAD-PE- 559-4A | 106.64 105.59 | 0.03 | 98.00 | 60 + 5+ 1.42 | |
| | CAD 5554 | 89.51 86.72 | 0.01 | 96.00 | 40 5+ 1.94 | |
| | Sw!ss P-1529 | 76.92 80.31 | - | 100.00 | | |
| Table 7. (cont) | RAD-PE- 559-3B | densities of: 85.57 87.72 | 0.03 | 91.00 | 60 + 5+ 1.32 | |
| Ţ | RAD-PE- 559-3A | at loading c 93.33 94.08 | 0.03 | 94.00 | 60 ÷ 5+ 1.43 | |
| | Swiss P-2078 | RQ vs P-2078 100.00 100.00 100.00 | 1 | 102.00 | | |
| | Ingredient or attribute | +90°F clased bomb avg 0.1 g/cm 0.15 g/cm 0.2 g/cm | Dust., % | AP case cap, g | Stability heat test: S.F. 134.5°C, minutes No explosion, hours Hygroscopicity, % | |
| | | | | | 24 | |

Table 8. FACC reported gun test data for the first multi-perforated lots RAD-PE-559-4A and 4B

Lot RAD-PE-559-4A (2.46% MC)

| Test | Charge weight, | Action time TA, ms | Chamber pressure, MPa | Muzzle velo with corre 12 m/s/m | |
|--|--|--|--|--|--|
| 1 2 3 | 85 92 95 | 5.37 4.94 4.50 | 289 342 415 | 1213 1277 1343 | 1223 1287 1353 |
| | | Lot RAD-PE- | 559-4B (3.88% M | (C) | |
| 1 2 3 | 85 90 95 Blen | 7.01 6.13 5.33 ds of lots | 201 209 286 RAD-PE-559-4A a | 1100 1148 1232 and 4B | 1110 1158 1242 |
| | 4A/4B (g/g) | | | | |
| 1 2 3 4 5 6 7 Avg of 5 | 85/10 = 95 g 85/15 = 100 g 80/20 = 100 g 75/25 = 100 g 70/30 = 100 g 60/40 = 100 g 50/50 = 100 g | 4.55 4.28 3.90 3.92 3.82 3.83 4.02 3.96 | 408 445 416 420 417 420 389 383 | 1324 1376 1361 1353 1348 1335 1329 | 1324 1386 1372 1363 1358 1345 1339 |

Table 9. Methyl centralite coating studies for propellant for APDS-T projectile

| | 559-5A | S59-5B | 559-5C | 559-5D | 559-5E | 559-7 | 559-8 |
|---|------------------|-----------------|------------------|------------------------|-----------------|------------------|------------------|
| Propellant Delivered, 1b | 109 | 110 | 110 | 106 | 107 | 474 | 488 |
| NC Blend No. | BC-15058 | BC-15058 | BC-15058 | BC-15058 | | C-15058 | C-15058 |
| Nitrogen Z | 13.19 | 13.19 | 13.19 | 13.19 | 13.19 | 13.12 | 13.12 |
| Solvents | | | | | | | |
| Total % | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Alcohol X | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| Ether Z | 65 | 65 | 65 | 65 | 65 | 65 | 65 |
| SR build up (hours) | 64 24 | 64 | 64 | 64 | 64 | 64 24 | 64 24 |
| SR time (hours) WD time (days) | 24 26 | 24 26 | 24 26 | 24 26 | 24 26 | 24 26 | 26 |
| Methyl centralite | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Coating cycle (hours) | 3/4 | 3/4 | 3/4 | 3/4* | 3/4* | 1-1/8* | 3/4* |
| FAD after coating (hours) | 104 | 104 | 104 | 96 | 96 | 96 | 96 |
| Nitrocellulose, 7 | 95.63 | 95.22 | 94.75 | 96.72 | 96.19 | 96.32 | 96.17 |
| Diphenylamine, % | 0.90 | 0.86 | 0.88 | 0.88 | 0.88 | 0.83 | 0.83 |
| Graphite % | 0.16 | 0.16 | 0.16 | 0.10 | 0.09 | 0.12 | 0.13 |
| Methyl centralite % | 2.53 | 3.03 | 3.51 | 1.39 | 1.89 | 1.97 | 2.08 |
| Potassium sulfate % | 0.94 | 0.89 | 0.86 | 0.91 | 0.95 | 0.88 | 0.92 |
| Residual solvents % | 1.38 | 1.15 | 1.04 | 1.17 | 1.11 | 1.29 | 1.20 |
| Alcohol % | 0.98 | 0.72 | 0.65 | 0.80 | 0.74 | 0.98 | 0.91 |
| Ether % Moisture (1 +.25) % | 0.40 1.16 | 0.43 1.08 | 0.39 1.04 | 0.37 0.91 | 0.37 0.83 | 0.31 0.92 | 0.29 0.70 |
| Total volatiles % | 2.54 | 2.23 | 2.08 | 2.36 | 2.58 | 2.21 | 1.90 |
| Hygroscopicity Z | 1.24 | 1.25 | 1.25 | 1.34 | 1.22 | 1.28 | 1.24 |
| Hygroscopicity % 3 Bulk Density (g/cm ³) | 1.24 0.9947 | 0.9994 | | | | 1.0005 | 1.008 |
| Heat of explosion (cal/g) | 872.1 | 861 | 847.2 | 901.2 | 889.7 | 883.2 | 886.3 |
| | | | | | | | |
| Die SP Spec | | | | | | | |
| Length, in. | 0.130 | 0.130 | 0.130 | 0.130 | 0.130 | 0.130 | 0.130 |
| Diameter in. | 0.147 | 0.147 | 0.147 | 0.147 | 0.147 | 0.147 | 0.147 |
| Pin diameter, in. Av web (green), in. | 0.014 0.0263 | 0.014 0.0263 | 0.014 0.0263 | ს.014 0.0263 | 0.014 0.0263 | 0.014 0.0263 | 0.014 0.0263 |
| • | 0.0203 | 0.0203 | 0.0203 | 0.0203 | 0.0203 | 0.0203 | 0.0203 |
| Firished | 0 0022 | 0 0022 | 0 0022 | 0 0023 | 0 0022 | 0 0023 | 0 0022 |
| Length, in. Diameter, in. | 0.0923 0.0947 | 0.0923 | 0.0923 0.0947 | 0.0923 0.0947 | | 0.0923 0.0947 | 0.0923 0.0947 |
| Perf diameter, in. | 0.0083 | 0.0083 | 0.0083 | 0.0083 | | 0.0083 | 0.0083 |
| Av web, in. | 0.0178 | 0.0178 | 0.0178 | 0.0178 | _ | 0.0178 | 0.0178 |
| L/D | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| D/d | 11.38 | 11.38 | 11.38 | 11.38 | 11.38 | 11.38 | 11.38 |
| Length var (%) | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 |
| Diameter var (%) | 2.59 | 2.59 | 2.59 | 2.59 | 2.59 | 2.59 | 2.59 |
| Web diff (%) | 11.96 | 11.96 | 11.96 | 11.96 | 11.96 | 11.96 | 11.96 |
| Outer web, in. | 0.0189 | 0.0189 | 0.0189 | 0.0189 | | 0.0189 | 0.0189 |
| Inner web, in. | 0.0168 | 0.0168 | 0.0168 | 0.0168 | 0.0168 | 0.0168 | 0.0168 |
| Gum test at Ford Aeronutronics Velocity 70°F (1350 ± 15 m/s) -65° | 1230 | 1250 | 1215 | 1300 | 1320 | 1320 1306 | 1326 |
| 160° | | | | | | 1354 | |
| Pressure | | | | | | | |
| Av chamber pressure 70°F (402 MPa max) | 352 | 303 | 283 | 448 | 386 | 385.6 | 464.8 |
| (+0.72 S. D.) | 332 | 202 | 203 | 440 | 300 | 393 | 404.8 |
| -65°F (496 MPa max) | | | | | | 371-9 | |
| (+5 S. D.) | | | | | | 5,245 | |
| 160°F (496 MPa max) (+5 S. D.) | | | | | | 428.1 | |
| Charge weight g | 98 | 98 | 98 | 90 | 98 | 98 | 96 |
| Action time (6.0 ms max) 70° -65° | | | | | | -3.3 3.5 | 3.9 |
| 160* | 05 - | | 00.1 | | | 3.4 | |
| RQ % | 95.5 | 91.3 | 83.6 | 105.0 | 101.9 | 102.70 | 104.89 |
| RF % Std lot | 97.7 P-2078 | 98.0 P-2078 | 96.8 P-2078 | 98.9 P-2078 | 98.6 P-2078 | 98.12 P-2078 | 98.96 P-2078 |
| JEG 100 | 1-20/0 | 1-20/0 | 1-2010 | 1-1010 | 1-2010 | 1-2010 | · -4010 |

Washed at coating temperature from 15 to 25 minutes, rather than dropping immediately to room temperature at the end of coating cycle and washing with cold water. These were the only batches thus treated.

Table 10 · Acceptance test results for lots RAD-PE-559-11, 15, 16 and 17

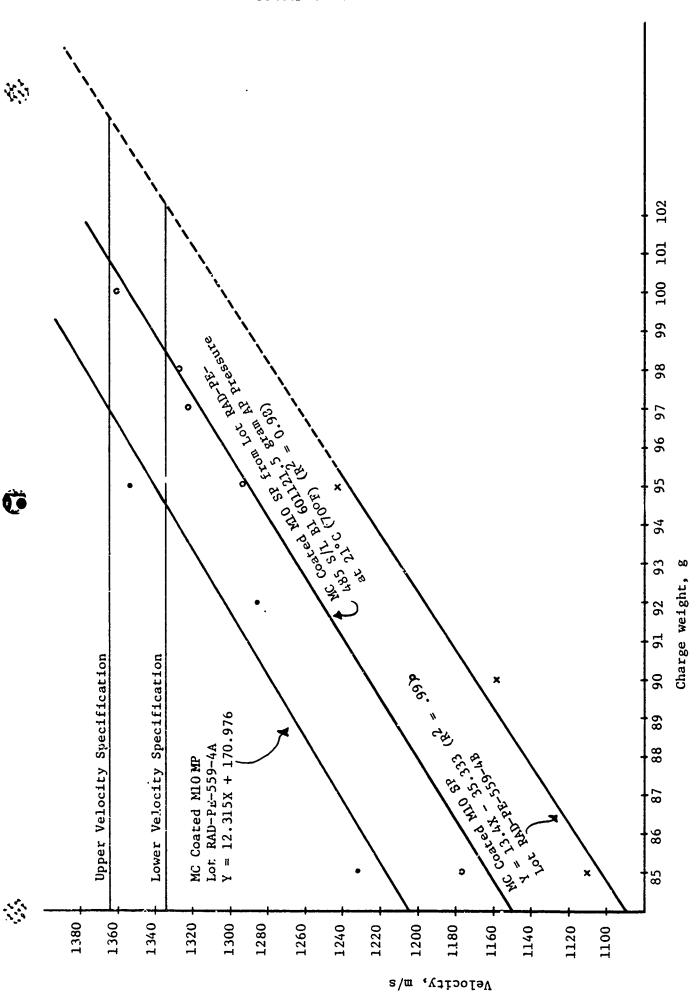
| 484 | | <u>559-11</u> | <u>559-15</u> | 559-16 | 559-17 | Avg | Std Dev |
|-------|---|-----------------|-------------------|------------------|-----------------|-----------------|------------------|
| | Propellant Delivered, 1b | 971 C-15104 | 4810 C-15134 | 6999 C-15228 | 5032 C-15315 | N/A | N/A |
| | NC Blend Nitrogen % | 13.16 | 13.16 | 13.16 | 13.15 | | |
| | Solvents | 2010 | | | | | |
| | Total % | 0.92 | 0.92 | 0.92 | 0.92 | | |
| | Alcohol % | 35 | 35 65 | 35 65 | 35 65 | | |
| | Ether % SR build up (hours) | 65 12 | (70°) 32 (1/8 in. | P.P.) 32 | 32 | | |
| | SR time (hours) | 34 | (70°) 32 (1/4 in. | P.P.) 32 | 32 | | |
| | WD time (days) | 12 | (95°) 24 (1/4 in. | P.P.) 24 | 24 | | |
| ; | Methyl centralite | _ | • | • | • | | |
| | coating cycle (hours) | 2 24 | 2 48 | 2 48 | 2 48 | | |
| | FAD after coating (hours) | | | | | 06 00 | 0 220 |
| | Nitrocellulose, % | 96.71 0.89 | 96.34 0.86 | 96.28 0.86 | 95.88 0.83 | 96.30 0.86 | 0.339 0.024 |
| | Diphenylamine, % Graphite % | 0.17 | 0.20 | 0.19 | 0.14 | 0.175 | 0.0265 |
| | Methyl centralite % | 1.92 | 2.24 | 2.41 | 2.15 | 2.18 | 0.204 |
| | Potassium sulfate % | 0.48 | 0.56 | 0.45 | 1.14 | N/A | N/A |
| | Total volatiles % | 2.48 | 2.01 | 1.93 | 1.68 | 2.03 | 0.35 0.111 |
| | Moisture (1 <u>+</u> .25) Residual solvents | 1.18 1.30 | 1.23 0.78 | 1.00 0.93 | 1.24 0.44 | 1.16 0.86 | 0.111 |
| | Alcohol Z | 1.50 | 0.30 | 0.41 | 0.24 | 0.32 | 0.086 |
| | Ether % | | 0.48 | 0.52 | 0.20 | 0.40 | 0.174 |
| | Hveroscopicity . | 1.38 | 1.38 | 0.99 | 1.33 | 1.27 | 0.188 |
| | Bulk Density (g/cm ³) | 1.01 | 1.011 | 1.011 | 0.999 | 1.008 | 0.0059 |
| | Heat of explosion (cal/g) | 897.4 102 | 900.5 | 889.9 | 892 | 895 | 4.87 |
| | Loadability, g | 102 | 103.6 | 101 | | 102.2 | 1.31 |
| | <u>Die</u> | A | | A | A | s- / s | 27/1 |
| | Length, in. | 0.110 | 0.110 | 0.110 . 0.147 | 0.110 0.147 | n/a | N/A |
| | Diameter in. Pin diameter, in. | 0.147 0.014 | 0.147 0.014 | 0.014 | 0.014 | | |
| 44 | Av web (green), in. | 0.026 | 0.026 | 0.026 | 0.026 | | |
| (F | Finished | | | | | | |
| | Length, in | 0.1062 | 0.0996 | 0.0980 | 0.104 | 0.102 | 0.0038 |
| | Diameter, in | 0.0949 | 0.0941 | 0.0931 | 0.0935 | 0.0939 | 0.00078 |
| | Perf diameter, in. | 0.0077 | 0.0068 | 0.0064 | 0.0064 | 0.0038 | 0.00061 |
| | Av web, in. | 0.0180 1.12 | 0.0186 1.06 | 0.0187 1.05 | 0.0186 1.11 | 0.0195 1.085 | 0.00032 0.035 |
| | L/D D/d | 12.35 | 13.89 | 14.44 | 14.59 | 13.92 | 1.023 |
| | Length var (%) | 1.97 | 1.65 | 2.07 | 1.83 | 1.88 | 0.182 |
| | Diameter var (%) | 1.55 | 2.22 | 1.59 | 1.96 | 1.83 | 0.319 |
| | Web diff (%) | 17.09 0.0196 | 8.31 0.0194 | 5.62 0.0192 | 8.78 0.0194 | 9.95 0.0194 | 4.909 0.00016 |
| | Outer web - in. Inner web - in. | 0.0165 | 0.0179 | 0.0181 | 0.0178 | 0.0176 | 0.00073 |
| | | | 1306 | 1348 | 1342 | | |
| | Gun test at Ford Aeronutronics Velocity 70°F (1100 ± 15 m/s) -65° | | 1300 | 1340 | 1342 | | |
| | 160° Pressure | | | | | | |
| | Av. chamber pressure 70°F (402 MPa max) | | 357 | 373 | 418 | | |
| | (+q.72 S. D.) | | J., | 3.3 | 720 | | |
| | -65°F (496 MPa max) | | | | | | |
| | (+5 S.D.) | | | | | | |
| | 160°F (496 MPa max) (+5 S. D.) | | | | | | |
| | Charge weight | | 98.3 | 99.7 | 99 | | |
| | Action time (6.0 ms max) | | | | | | |
| | 70° | | 3 1 | 2 2 | 3.22 | | |
| | -65° 160° | | 3.4 | 3.3 | 3.44 | | |
| | RQ X | 97.89 | 101.95 | 100.76 | 100.33 | | |
| | RF 7 | 100.42 | 100.24 | 190.01 | 99.09 | | |
| .50 | Std lot | PZ-559-7 | PE-559-11 | PE-559-15 | PE-559-16 | | |
| | | | | | | | |
| 4 . P | | | | | | | |
| | | | 27 | | | | |
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Regression

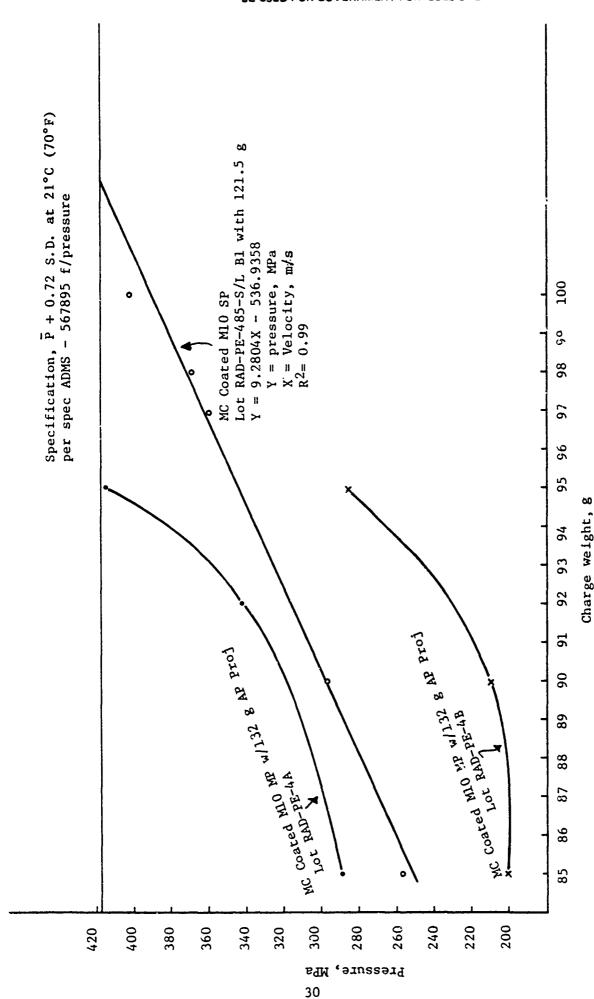
Effects measured on samples of Bushmaster propellant taken at stated time in minutes during an elevated temperature coating cycle Table 11.

| DPA, | 0.84 | 0.92 | 0.83 | 0.83 |
|---|--------|--------|--------|--------|
| MC, % | 1.25 | 1.44 | 1.60 | 1.75 |
| HOE, | 939.0 | 931.7 | 919.4 | 912.4 |
| 2-559-7 % RF | 102.05 | 102.19 | 101.05 | 100.31 |
| ot RAD-PE % RQ2 | 116.68 | 111.58 | 106.78 | 102.47 |
| Versus lot RAD-PE-559-7 HOE, % RQ1 % RQ2 % RF cal/g | 119.69 | 113.55 | 108.08 | 103.03 |
| Residual solvent, | | | | 0.89 |
| Ethyl ether, % | 0.92 | 0.78 | 0.68 | 0.62 |
| Ethyl alcohol, % | 0.20 | 0.21 | 0.24 | 0.27 |
| H20, | 0.70 | 1.04 | 1.68 | 1.86 |
| GCTV, | 1.82 | 2.03 | 7.60 | 2.75 |
| Time on cycle, min | 30 | 09 | 95 | 120 |
| Sample | P2579 | P2580 | P2581 | P2582 |

| 函 | ffect | 6 | Effect equation | coefficient |
|---|--------------------|----------|---|-------------|
| | HOE | 11 | = -54.1607 MC + 1007.2721 | -0.99 |
| | % MC | 11 | : 0.00553 T (min) + 1.073 | |
| % | % Ether | 11 | -0.003288 T (min) + 1.0007 | -0.989 |
| | RQ2 | 11 | -28.0008% MC + 151.5888 | -0.9997 |
| | RQ1 | B | 32.7550% MC + 160.4656 | -0.9997 |
| | % H ₂ 0 | II | -4.0543% ether + 4.3607 | -0.9795 |
| | RQ_1 | 11 | $Q_1 = 1.1687915\% \text{ RQ}_2 - 16.75199$ | +0.9995 |
| | | | | |



SP and M10 MP pilot lots with 132 and 1.25 m/s/m, muzzle velocity correction factor. of first RAAP MC coated M10 $(70^{\circ}F)$ with 121.5 gram projectiles at 21°C FACC gun test Figure 1.



FACC gun tests of first RAAP MC roated M10 BP and M10 MP pilot lots with 132 and 121.5 gram APDS-T projectiles at $21^4 \rm C$ (700F) Figure 2..



بينته بينه بينه منه ويوني ويوني ويواري ويواري ويواري ويواري ويواري والاماري ويواري ويواري ويواري ويواري

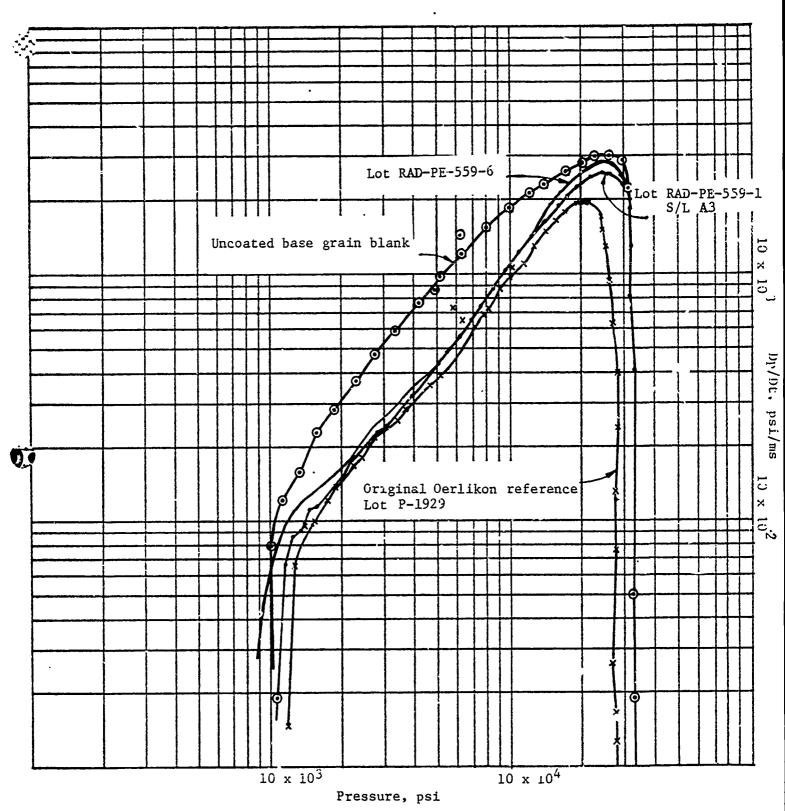


Figure 3. Closed bomb traces of HEI-T pilot and production lots compared with uncoated base grain blank, and the griginal Olikeron reference lot P-1929 (loading density 0.2 g/cm, 200 cm closed bomb 90°F testing temp).

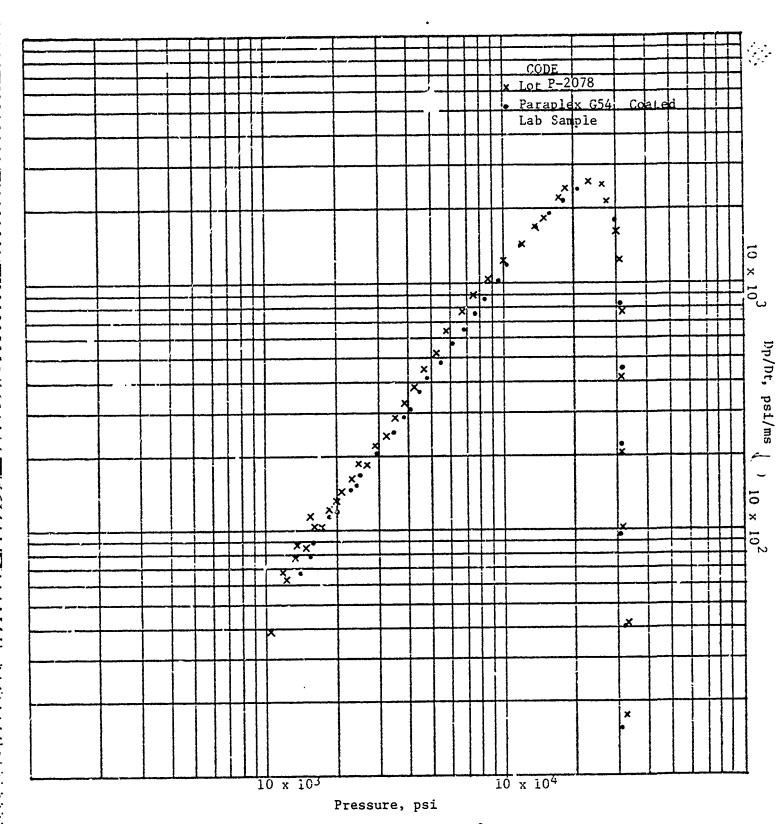
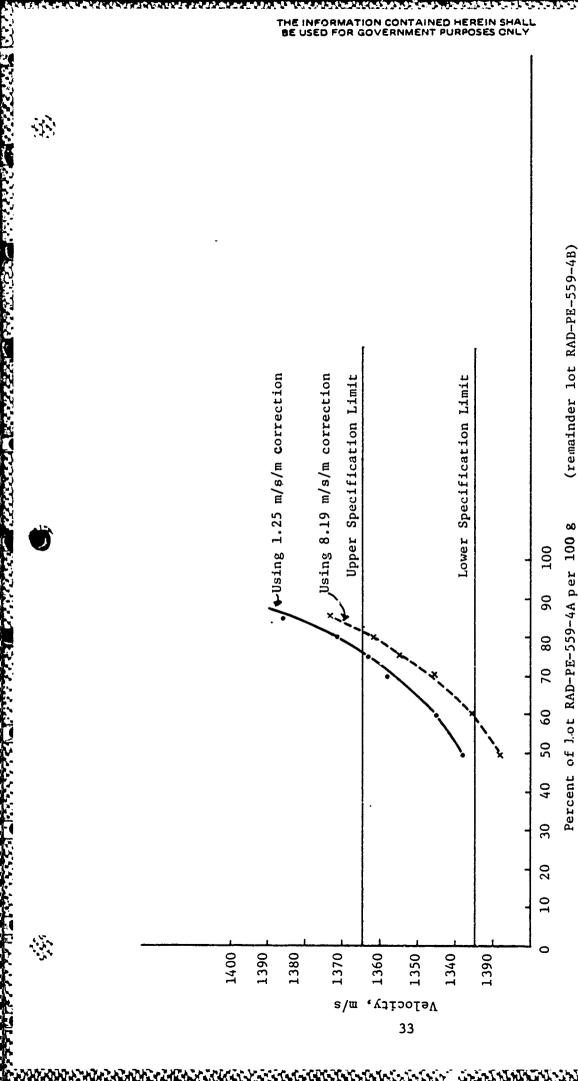
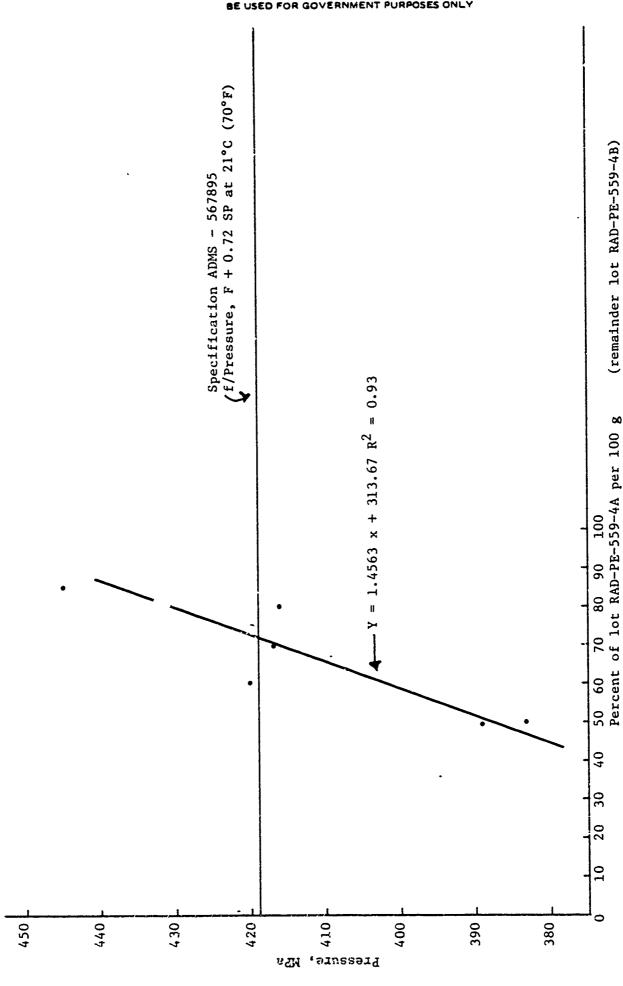


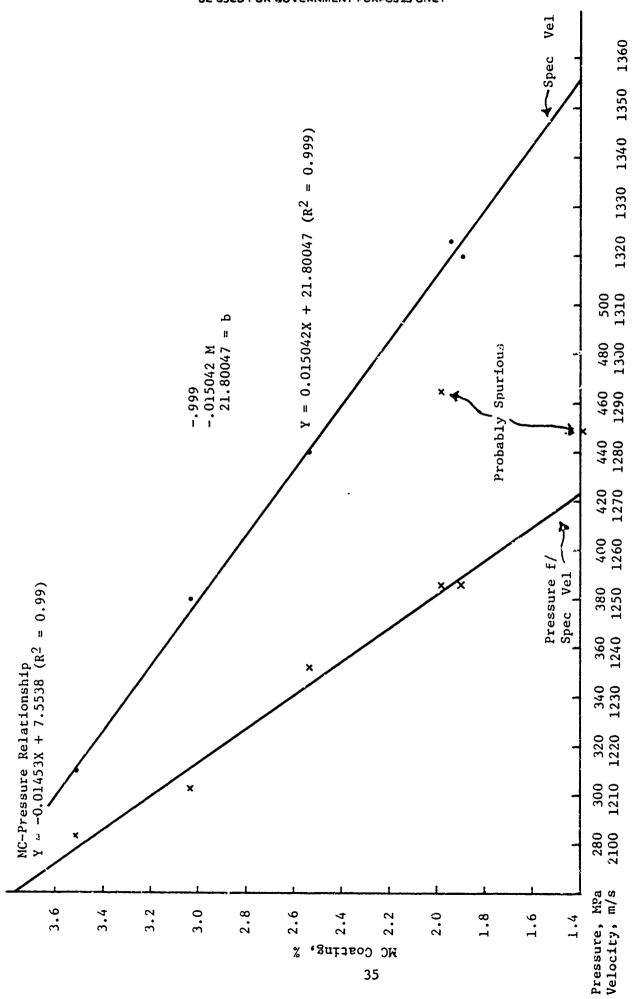
Figure 4. Closed bomb traces (200 cm³ bomb, 0.2 g/cm³ loading density and 90°F) showing close relationship between Paraplex G54 coated laboratory sample and original reference lot.



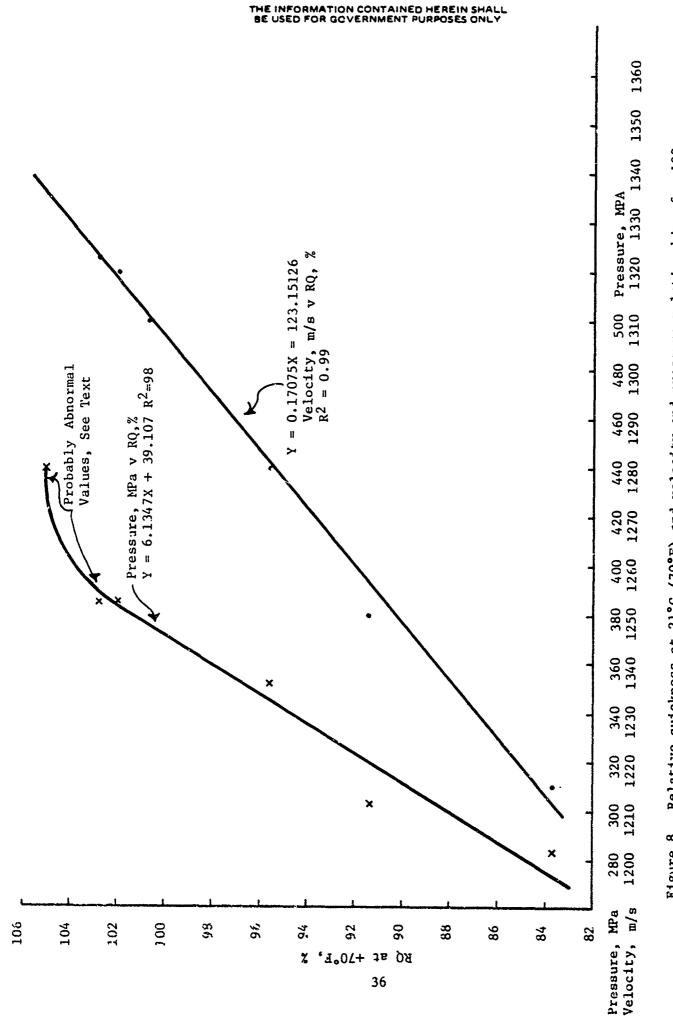
Mffect on velocity of blending high and low quickness lots RAD-PE-559-4A and 4B at 100-gram charge weights, ۍ. Figure



Effects on pressure of blending high and low quickness lots RAD-PE-559-4A and 4B at 100-gram charge weights 6 Figure

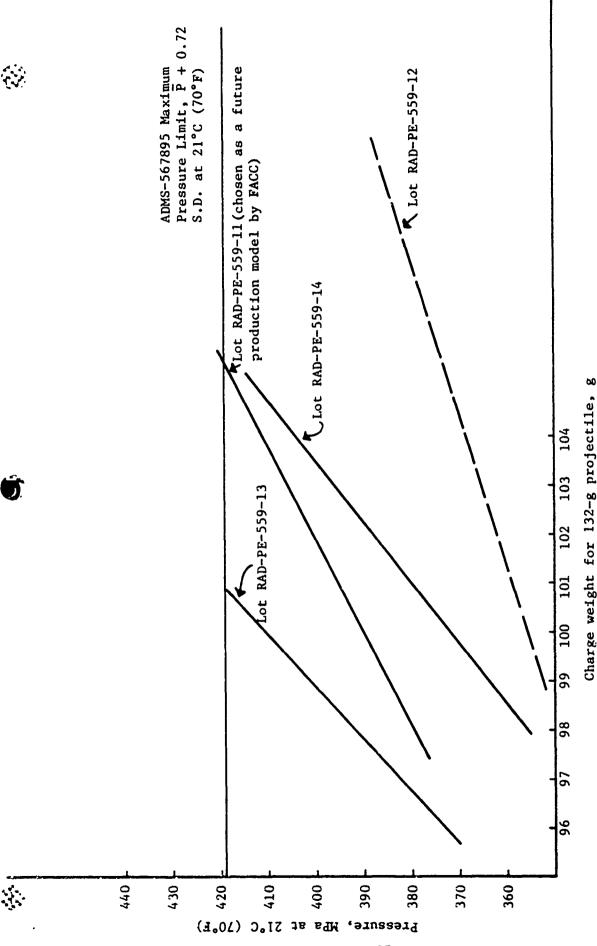


Methyl centralite and 21°C (70°F) velocity and pressure relationships for 132-gram APDS-T C, E, and 7. projectiles with 12 m/s/m velocity corrections for lots RAD-PE-559-5A, B, Figure 7.



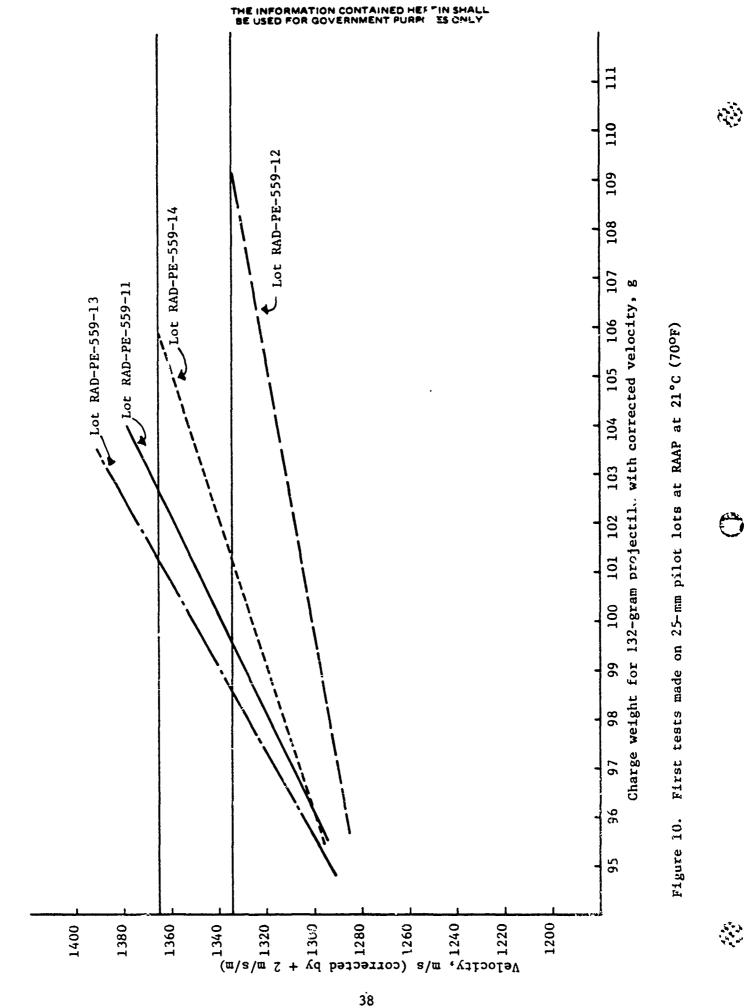
Relative quickness at 21°C (70°F) and velocity and pressure relationships for 132-gram APDS projectiles with 12 m/a/m velocity corrections for lots RAD-PE-559-5A, B, C, E, and 7. Figure 8.

1



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Figure 9. First tests made at RAAP on 25-mm pilot lots

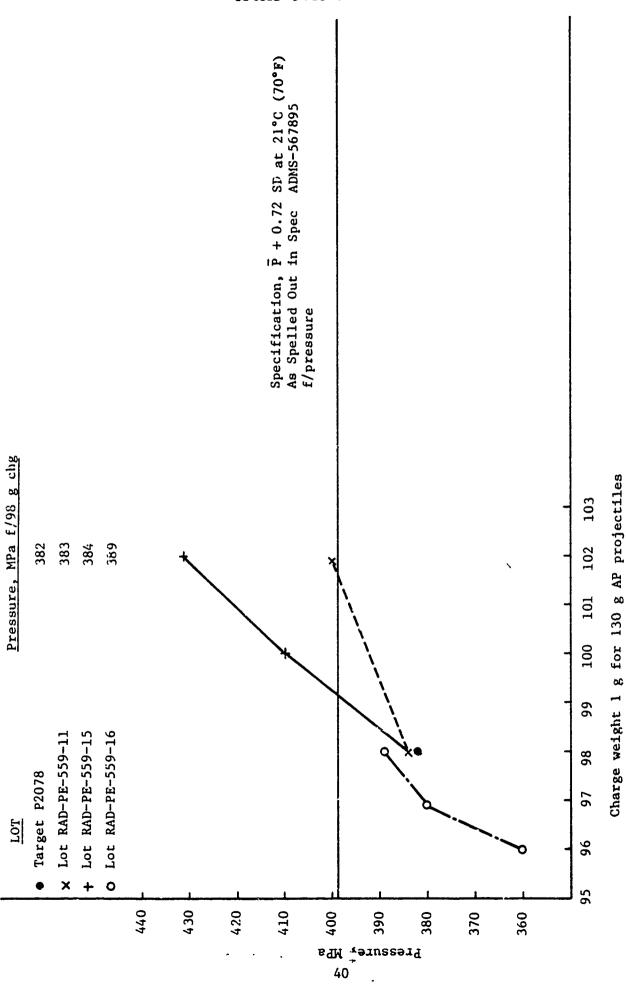


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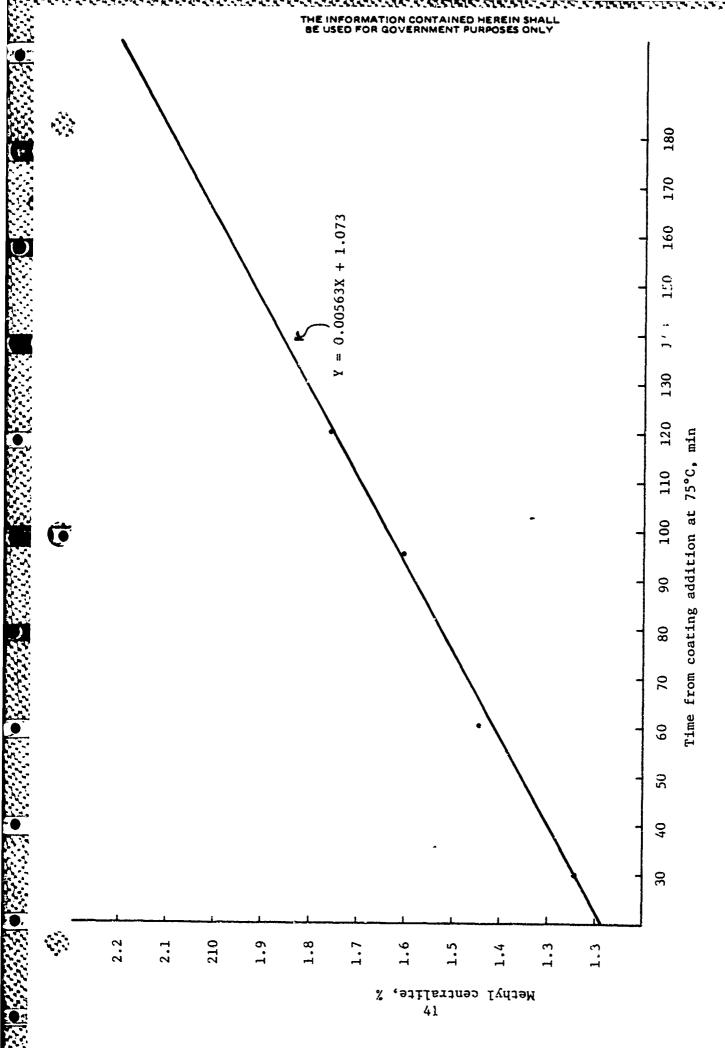
. 39 . : . 39

Velocity - charge weight relationship for RAAP gun tests Figure 11.

Charge weight for 132-gram projectile,



for RAAP gun tests Pressure - charge weight relationship Figure 12.



Relationship between coating cycle time and percent of methyl centralite applied Figure 13.

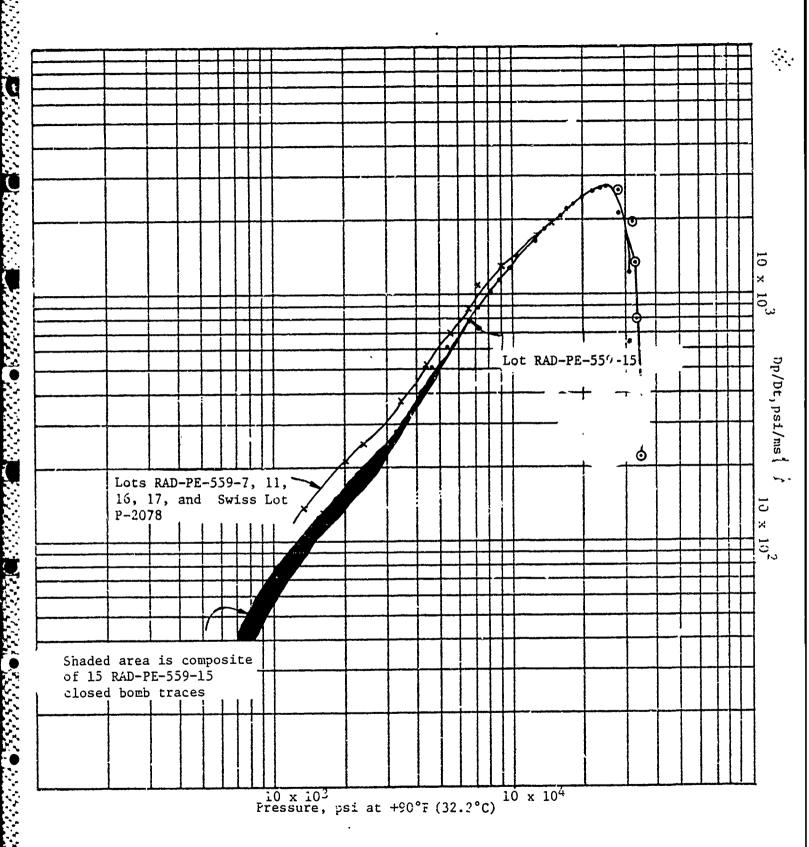


Figure 1:. Closed bomb Dp/Dt versus P traces of Lots RAD-PE-559-15 compared with lots RAD-FE-559-11, 16, and 17 and Ewiss lot P-2078.



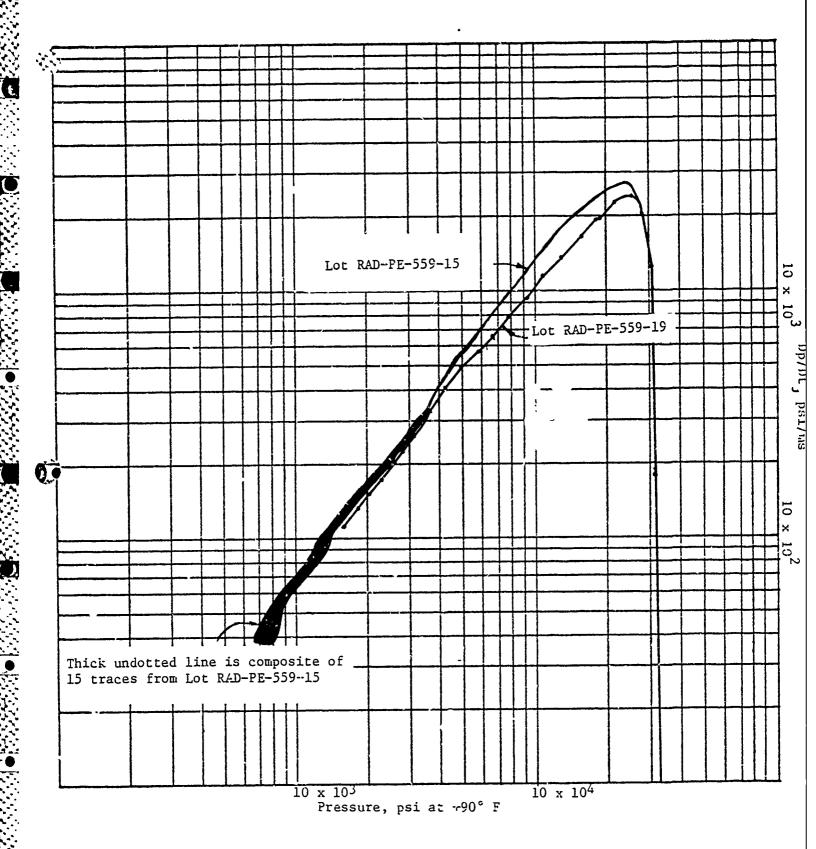
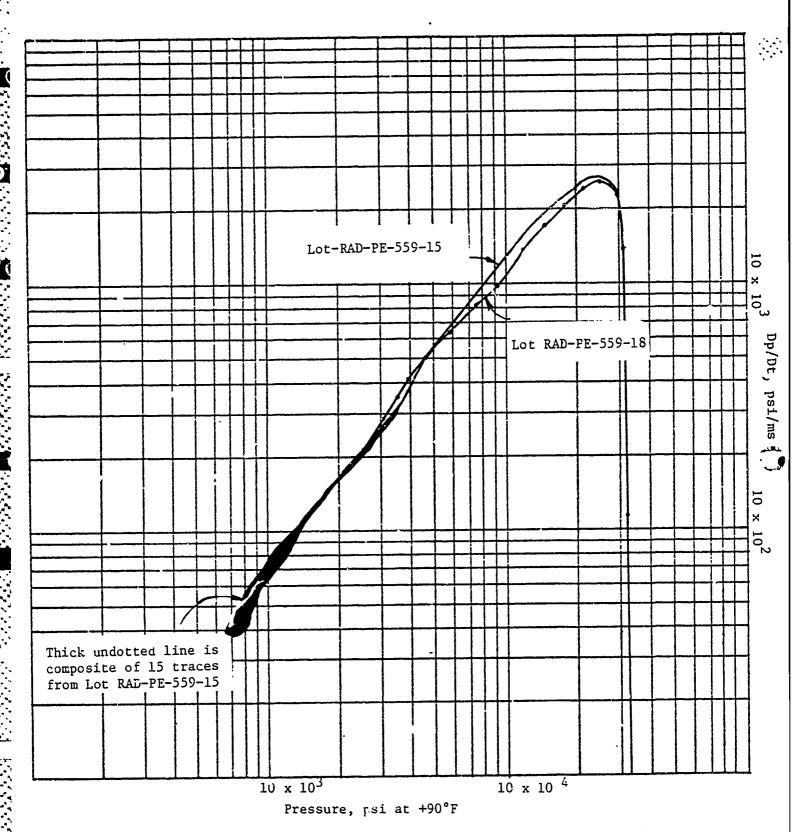


Figure 15. Comparison of Lot RAD-PE-559-15 with dual-coated (MC and DNT)lot RAD-PE-559-19.



Tigure 16. Comparison of lot RAD-FE-559-15 with dual-coated (MC and DNT) lot RAD-PE-559-18

APPENDIX A

SPECIFICATIONS

- A-1. Propellant Requirements for Single-Base, Single Perforated, Methyl Centralite Coated CR B 325, RSA-1
- A-2 Propellant Requirements for the AP-T and HEI-T Rounds and Modifications of Scope of Work
- A-3 Special Request Order of Propellant Manufacture
- A-4 Product Specification for 25-mm APDS-T Propellant
- A-5 Product Specification for 25-mm Cartridge, APDS-T, M791

APPENDIX A-1

Propellant Requirements for Single-Base, Single Perforated, Methyl Centralite Coated CR B 325, RSA-1

Propellant Chemical and Physical Requirements (1)

| Nitrocellulose, SPEC MIL-N-244 % | Rem | aind | er |
|---|-------|----------|-------|
| Nitrogen in Nitrocellulose % | 13.15 | <u>+</u> | 0.05 |
| Diphenylamine, SPEC MIL-D-98 % | 0.50 | to | 1.25 |
| Graphite, SPEC MIL-G-135 (max) % | | 0.40 | |
| Methyl Centralite, SPEC MIL-M-19719 % | | 3 mi | a |
| Potassium Sulfate, SPEC MIL-P-193 % | 0.10 | to | 1.00 |
| Total Volatiles (max) % | | 2.35 | |
| Moisture and Volatiles % | 1.00 | <u>+</u> | 0.35 |
| Residual Solvents (max) % | | 1.10 | |
| Hydroscopicity(max) % | | 1.80 | |
| Heat Test 134.5°C | | | |
| A. Discoloration-minutes to salmon pink | | 40 | |
| B. Explosion Hours | | 5 | |
| Dust and Foreign Matter (max) % | | 0.10 | |
| Bulk Density, g/cc | 0.90 | to | 1.050 |
| Dimensions - In. | | | |
| Mean Lengti. (L) | 0.073 | to | 0.085 |
| Mean Diameter (D) | 0.060 | to | 0.066 |
| Mean Diameter of Perforations (d) | 0.006 | to | 0.010 |
| Mean WEB (W) | 0.025 | to | 0.030 |

(1) Military Standard 286 Applies



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APPENDIX A-2

Propellant Requirements for the AP-T and HEI-T Rounds and Modifications of Scope of Work

1. Propellant Description

The propellant requirements for the AP-T and HEI-T rounds are as follows:

| | HEI-T | 7 MP Single Base AP-T |
|---|-----------------|-----------------------|
| Projectile Weight (grams) | 187 | 132 |
| Available Chamber Volume (cm ³) | 92.2 | 98 |
| Projectile Travel (mm) | 1867 | 1867 |
| Nominal Bore Diameter (mm) | 25 | 25 |
| Shot Starc Pressure (psi) | 3,000 | 2,000 |
| Action Time (M-Sec) | < 5 | |
| Interior Ballistics | | |
| Muzzle velocity (fps) | 3600 ± 50 (min) | 4400 ± 50 |
| Muzzle Pressure (psi) | 6000 (max) | 5000 (max) |
| Peak Chamber Pressure () | 56.6 (ambient) | 56.6 (ambient) |
| Barrel Travel Time (ms) | 3.0 | 3.0 |
| Propellant Characteristics | | |
| Max. Isochoric Flame Temperature | 2800 | 2800 - |
| Mass Impetus (Ft Lb) | 330,000 | 330,000 |

A common ignition system will be provided for both the rounds. Initially, the ignition system for both these rounds will be the Ml15 primer with approximately 1.3 grains Class 6 black powder booster. An improved ignition system is being developed and will be provided when available.

2. Quantities

Samples of propellants for both these rounds will be screened at the propellant plant and then shipped to Aeronutronic for evaluation in standard test gun using standard propellant for comparison.

A gun will be provided to the propellant manufacturer for development testing. Final ballistics evaluation of propellant will be done at Aeronutronic test facilities.

It is estimated that six samples of each of the two types of propellant will be required for preliminary evaluation. Size of these samples required is approximately 6-18 pounds each.

beronutronic will supply standard components with a prime booster system common to both the AP and HE-I rounds.

Larger quantities of the candidate propellant (1000 lb lots) will be required for propellant characterization. It is estimated that approximately 16,000 rounds will be evaluated at the Aeronutronic test facility.

The entire program calls for 750,000 rounds.

Time Frame

A copy of the ammunition schedule is attached. The propellant development program will start in January 1976 and will be completed in June 1976.

A total of 75,000 rounds are to be delivered in February 1977. These are broken down as follows:

| TP Rou | 50,000 | |
|--------|----------------------|--------|
| | - 12,500 - 12,500 | 25,000 |

75,000 rounds

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APPENDIX A-3 Special Request Order of Propellant Manufacture BERARDER OF THE ARMY RADPORT OF THE ARMY RADPORT OF THE ARMY

RADVORD, VINCENIA 24141

10 NOV 1977

SARRA-EN

Manager Hercules Incorporated Radford Army Ammunition Plant Radford, Virginia 24141

Dear Sir:

Reference is made to a meeting held at this installation on 2 November 1977, concerning the 25mm Bushmaster Work Program (PE-559).

Within funds evailable under PR-559, Propellant for 25mm Bushmaster, authority is granted to produce the following propellant lots:

| Pounds | T\D | MC Coating, * percent |
|---------|-----|--|
| a. 2000 | 1.1 | (a) 1000 lbs, 2.30% (b) 1000 lbs, 1.70% |
| ъ. 2000 | 1.3 | (c) 1000 lbs to be determined (d) 1000 lbs at a later date |

^{*} Select final (a) and (b), and (c) and (d) from preliminary coating and firing (Mann Gun) and closed bomb (a) and (b) to be blendable.

The following process changes from lots PE-559-7 and PE-559-8 apply:

- s. K,804 reduced to 0.50 percent.
- b. Nitrogen content high side of spec. N_2 (13.20%).
- c. Water Dry adjustment.

Sincerely yours,

CHARLES E. FLYNN Contracting Officer's Representative

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4-29-76

MODIFICATION OF SCOPE OF WORK

BUSHMASTER

PE-559

- Change from methyl centralite which is not available in U.S.
 Try other coatings. Suggest we try EDM, Paraplex, ethyl centralite.
 Send 10 1b samples of promising candidates to Aeronutronic Ford for evaluation.
- 2. Coat 900+ 1bs, Lot A3 (A1 & A2) at 4.75% MC.
- Discuss need to reduce action time.
 Reduce coating level.
- 4. Coat 200 1bs Lot B3 with 3.90%* MC. --
- 5. a. Try multiple perf grain (7) for AP.

 Start with single-base

 Make small lot with 7MP similar to Oerlikon dimensions, but with Lot B formula with methyl centralite.
 - b. No objection to double-base if it meets flame temperature requirements.
 - c. No objection to triple-base if nitroguanidine can be obtained in USA (or Canada).
- Send components.
 Send primed cases and projectiles AP and TP.
 Send modi. 'tion to crimper.
- 7. Send propellants specifications for AP and HEI-TP rounds.
- * Analyzed

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

| REVISIONS | | | | | | | |
|-----------|-------------------------------|------|----------|--|--|--|--|
| LTR | DESCRIPTION | DATE | APPROVED | | | | |
| - | LIMITED RELEASE PER EO C33179 | | | | | | |
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PRELIMINARY ISSUE

THIS DOCUMENT CONTAINS INFORMATION LICENSED TO AERONUTRONIC FORD CORPORATION. USE OF SUCH INFORMATION IS LIMITED TO EVALUATION WITHIN THE GOVERNMENT, AWARD OF CONTRAC, 5 TO AERONUTRONIC FORD, AND ADMINISTRATION OF CONTRACT DAAA07-75-C-2045 AND OTHER AERONUTRONIC FORD CONTRACTS; PROVIDED, HOWEVER, AFTER GOVERNMENT ACCEPTANCE OF THE BUSHMASTER TECHNICAL DATA PACKAGE (TDP) UNDER CONTRACT DAAA09-75-C-2046, ANY INFORMATION HEREIN WHICH IS ALSO CONTAINED IN SAID TOP BECOMES USABLE BY THE U.S. ARMY UNDER LICENSE AS SPECIFIED IN SAID TOP.

*Now known as Ford Aerospace & Communications Corporation, Aeronutronic Division

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| CONTRACT NO. DAAA09-75-C-2048 | | AERONUTRONIC FORD CORP | | | | | | | |
|-------------------------------|---|--|--|--------------|--|--|---|--|--|
| PREPARED BY | AERONUTRONIC DIVISION NEWPORT BEACH, CALIFORNIA | | AERONUTRONIC DIVISION NEWPORT BEACH, CALIFORNIA 92 | | AERONUTRONIC DIVISION NEWPORT BEACH, CALIFORNIA 92 | | AERONUTRONIC DIVISION NEWPORT BEACH, CALIFORNIA | | |
| CHECKED BY | 1 | PROPELLANT, CARTRIDGE, | | | | | | | |
| RESPONSIBLE ENGINEER | | 25MM, ARMOR PIERCING - TRACED SIZE CODE IDENT NO. | | | | | | | |
| | SIZE | | | | | | | | |
| | Α | A 09205 ADMS567895 | | | | | | | |
| | | 52 | | PAGE 1 OF 12 | | | | | |

- 1. SCOPE
- 1.1 This specification covers propellant for use in armor piercing-traced (AP-T) 25 millimeter (mm) cartridge (see 6.1).
 - 2. APPLICABLE DOCUMENTS
- 2.1 Government documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-N-244

Nitrocellulose

STANDARDS

Ü

Military

MIL-STD-105

Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-286

Propellants, Solid, Sampling, Examination and Testing

- MIL-STD-1168

Ammunition Lot Numbering

DRAWINGS

U.S. Army

C9256486

Container, Packing PA 54, Wood With Metal Liner (Modified M24 Box for Smokeless Powder)

F7549033

Container, Metal, Universal, M24 for Propellant and Explosives, Assembly and Details

| 20-4-77 | Packing and Marking of Box, Packing for Smokeless Powders |
|---------|--|
| 76-4-46 | Box, Packing, Metal Liner (Copper), M24, for Smokeless Powders |
| 76-4-56 | Box, Packing, Metal-Wood, M17 for Smokeless Powders |
| 8858577 | Marking Diagram and Sealing of Container, Metal, Universal, M25 for Shipping of Propellant |
| 8858848 | Marking Diagram and Sealing of Metal Lined Wooden Packing Boxes for Ship- ment of Propellant |

OTHER PUBLICATIONS

U.S. Army

AMCR 715-505, Vol. 8
Ammunition Ballistic Acceptance
Test Methods
TECP 700-700, Vol. III
Manual of Test Methods for Small

Arms Ammunition

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

- 3.1 Chemical composition and physical properties. The finished propellant shall comply with the requirements specified herein. Applicable tests for chemical composition and physical properties of the propellant shall be performed in accordance with the procedures set forth in MIL-STD-286.
- 3.1.1 Composition. The propellant shall be of a conventional single or double base composition.
- 3.1.2 Nitrocellulose. Nitrocellulose recovered from the rework of propellants or new nitrocellulose with the nitrogen content not fully meeting the requirements of MIL-N-244 may be used in lieu of or in combination with complying nitrocellulose. Propellant so manufactured shall comply with all chemical, physical, and ballistic requirements.
- 3.1.3 Products of combustion. The products of combustion of the propellant shall not be corrosive to the gum barrel.

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ADMS567895

- 3.1.4 <u>Flame temperature</u>. The propellant shall have an isochoric flame temperature of not greater than 3060 Kelvin (K). The Hirschfelder method of calculation shall be used.
- 3.1.5 <u>Stability</u>. The propellant shall be stable and compatible with materials it contacts. Stability tests shall be performed in accordance with MD-STD-286.
- 3.1.6 Bulk density. The bulk density of this propellant shall be not less than 0.94 grams per cubic centimetre (g/cc).
- 3.2 Ballistics. The propellant, when loaded into the appropriate test cartridges (see 6.3), shall comply with the ballistic requirements as specified in the following subparagraphs.
- 3.2.1 Muzzle velocity (V_0). At plus 21.1 plus or minus 1.1 degrees Celsius '), the average value of V_0 plus 0.72 standard deviation shall not fall above or below the following when using a 132 gram (g) Armor Piercing Practice (APP) projectile (see 6.3).

 \overline{V}_{O} + 0.72 S \leq 1356 metres per second (m/s)

$$\bar{V}_{0} - 0.72 \text{ S} \leq 1326 \text{ m/s}$$

The standard deviation of the group shall not exceed 10 m/s. A correction factor of 1.25 m/s per metre for the APP projectile shall be applied to the recorded velocity at the measured range to obtain initial V_0 . A total of 20 shots each shall be fired during lot acceptance at minus 53.9 degrees C, plus 21.1 degrees $^{\circ}$ C, and plus 71.1 degrees $^{\circ}$ C.

3.2.2 Pressure.

D.

- 3.2.2.1 Chamber. Simultaneously with the muzzle velocity measurements (see 3.2.1), the chamber pressure shall be measured with a Kistler Model 607B pressure transducer (or equal). Prior to pressure measurement, the sample cartridges shall be conditioned at minus 53.9 degrees C, plus 21.1 degrees C, and plus 71.1 degrees C. The maximum average pressure (P_{max}) values obtained from 20 firings at each temperature shall satisfy the following:
 - +21.1 degrees C: \bar{P} + 0.72 S \leq 4079 kg/cm²

$$\overline{P}$$
 + 5.14 S \leq 5062 kg/cm²

- -53.9 degrees C: \overline{P} + 5.14 S \leq 5062 kg/cm²
- +71.1 degrees C: \bar{P} + 5.14 S \leq 5062 kg/cm²
- 3.2.2.2 Muzzle. The muzzle pressure obtained with test cartridge shall not exceed 458 kilograms per centimetre squared (kg/cm²) at plus 21.1 plus or minus 1.1 degrees C.
- 3.2.3 Action time. The maximum action time (from primer contact to bullet-barrel exit time) in milliseconds (ms) shall not exceed 6.0 ms at any cartridge temperature from minus 53.9 to plus 71.1 degrees C.

- 3.2.4 Smoke and flash. The smoke and flash produced by test cartridges shall not exceed the smoke and flash produced by reference cartridges (see 6.2). This requirement applies to single shot firings and Bushmaster automatic gun firings through full rate.
- 3.2.5 Fouling. The test cartridges shall not produce fouling of the barrel, barrel bearings, muzzle attachments, ports or gas cylinders of the Bushmaster weapon to the extent that it will impair or prevent the normal functioning of the weapon.
- 3.2. Barrel erosion. The test cartridges shall not cause the average life per barrel to be less than with reference rounds. The barrel life shall be considered as having ended when the average velocity of an individual burst in the test drops 61 m/s or more with respect to that of the initial burst or when the bullets from 20 percent or more of the cartridges in any burst show keyholing which is defined as yaw exceeding 15 degrees at 25 metre range, whichever occurs first.
- 3.2.7 Air space. A minimum air space of zero linear inches shall be obtained when tested in accordance with the applicable procedure of MIL-STD-286.
- 3.2.8 Extreme temperature. The average muzzle velocity (see 3.2.1) and chamber pressure (see 3.2.2.1) of test cartridges subjected to specified temperature conditions (see table I) shall not vary from the average muzzle velocity and chamber pressure of similar test cartridges conditioned and fired at plus 21.1 plus or minus 1.1 degrees C by more than the amounts indicated in table I.

Table I. Characteristics variations at extreme temperatures

| Condition | Variation in average velocity (m/s) | Variation in average chamber pressure (kg/cm ²) |
|---|-------------------------------------|---|
| Stored at +71.1° +1.1°C for 4 hours and fired at that temperature | +61, | +705, -141 |
| Stored at -53.9° +2.8°C not less than 6 hours and fired at that temperature | +46, -76 | +141, -705 |

4. QUALITY ASSURANCE PROVISIONS

であるからない。 であるからないできません。 できません。 できまなもなる。 できません。 できません。 できません。 できません。 できません。 できまなもなる。 できまなもなる。 できまなる。 できまなる。 できまなる。 できまなる。 できまなる。 できまなる。 できるなる。 をもなるる。 をもなるる。 をもなる。 をもなるる。 をもなる。 をもな。

4.1 Responsibility for inspection. Unless otherwise specified in the contract or order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in



the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the procuring activity. The procuring activity reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

- 4.1.1 Quality assurance terms and definitions. Reference shall be made to MIL-STD-109 to define quality assurance terms used.
- 4.2 First-article sample. After inspection at source in accordance with the production lot acceptance tests for the first lot as cited in table II (acceptability shall be based on results of initial tests only, second tests are not permitted), a quantity of the first acceptable production lot (as prescribed by the procuring activity) shall be submitted to a procuring activity approved facility for first-article testing. The first production lot shall have been manufactured in the same manner, with the same materials, equipment, processes, and procedures as will be used in subsequent production lots and shall be packed in accordance with the contract or order. The first-article sample shall be inspected at a procuring activity approved facility for all the applicable requirements of the drawings and specifications.
- 4.2.1 First-article sample failure. Failure of the sample to comply with requirements of the drawings and specifications shall result in sample disapproval. Determination as to acceptability of any first-article sample shall be based upon result. of initial tests only, and no second tests shall be permitted on that first-article sample. In the event of first-article failure, disposition of the first production lot shall be determined by the procuring activity.
- 4.3 Inspection provisions. In all chemical, physical, and ballistic testing, the use of the equipment specified and the methods of test prescribed in this specification and other documents referenced therein shall be mandatory.

4.3.1 Lot.

- 4.3.1.1 Submission of product. The product shall be submitted in accordance with MIL-STD-105.
- 4.3.1.2 Size of lot. The propellant lot size shall be as agreed upon between the supplier and the contracting officer, provided the formation of the lot is in accordance with MIL-STD-105.
- 4.3.1.3 Lot identification. Each lot of propellant shall be identified with a lot number in accordance with MIL-STD-1168.
- 4.3.2 Sampling. Random representative samples shall be taken by random selection of one container from each identifiable increment of the lot. A random sample of five containers shall be selected from these representative samples. From each container selected, a sample shall be taken such that aggregate quantity shall be sufficient for the required chemical, physical, ballistic, and ballistic uniformity tests. These samples shall be poured into

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ADMS 567895

Table II. Conditioning and testing by lots

| Conditioning | Testing requirements by lots | | | | | | |
|---|------------------------------|---|---------|---------------------|-------|-----------------------|--------------|
| Citata | | | | | _ | oduction eptance | |
| | fi | Conditioned and fired at temperatures (a) | | | First | Second to fifth | Sixth lot |
| Characteristics | -53.9°C | +21.1°C | +71.1°C | sample tests (c) | 1ot | lot | on |
| Chemical com- position and physical properties | | | | X (d) | x | . x | Х (b) |
| Muzzle velocity | x | x | x | x | x | x | x |
| Chamber pressure | x | x | x | x | x | X | х |
| Muzzle pressure | | x | | x | x | x | x |
| Action time | x | x | | x | x | x | X |
| - Smoke | | x | | x | | | |
| Flash | | X | | x | | | |
| Fou ¹ ing | | x | | x | | | |
| Velocity uniformity | | . x | | x . | X | x | x |
| Barrel erosion | | x | | x · | | | |
| Air space | | x | | x . | х | x . ` | x |

NOTES: (a) Cartridge cases for pressure test to be drilled prior to being stored at specified temperature.

- (b) Except hygroscopicity.
- (c) First-article sample tests are performed by the procuring activity.
- (d) Squares marked "X" indicate conditioning/testing to be performed.



clean containers, immediately closed with a hermetically tight seal and identified as "Representative Sample" with a label showing the container number from which the sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Prior to conducting lot acceptance tests, these samples shall be permitted to attain room temperature, then equal portions sufficient to make the required quantity of a composite sample shall be taken from each "Representative Sample" and blended. This composite sample shall be placed in two separate containers, immediately closed with a hermetically tight seal and identified respectively as "Chemical Sample" and "Ballistic Sample". These containers shall be further identified by the container numbers from which the composite sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. The balance of the propellant remaining in each of the "Representative Samples" shall be used to perform the velocity uniformity test.

- 4.3.3 Tests. The following tests shall be performed in accordance with the provisions of 4.4.
- 4.3.3.1 Chemical composition and physical properties. The sample quantity of propellant to be tested for the chemical composition and physical properties requirements specified herein shall be as prescribed in MIL-STD-286. In the event of failure of the sample to comply with the requirements of 3.1, the procedure of note (a) of table III shall apply.
- 4.3.3.2 Ballistics. The ballistic tests shall be made in accordance with table II to determine compliance with the requirements of the cartridge (with 132g APP projectile) for which the propellant is intended. The "Ballistic Sample" shall be subjected to all of the tests prescribed in table III.
- 4.3.3.2.1 Velocity uniformity. Cartridges loaded with each of the "Representative Samples" shall be tested for velocity uniformity. These tests shall be conducted only at ambient conditions. Ten rounds from each of the "Representative Samples" shall be loaded at the same charge weight established for the "Ballistic Sample". The velocity shall be averaged for each 10-round test and the standard deviation determined. Criteria for "Ballistic Sample" charge esta

 "t velocity, variation of "Representative Sample" velocity from that of "Sample" and standard deviations for "Representative Sample" velocitie.
 - **Ballistic Sample" and "Representative Sample" muzzle velocity of 1341 m/s (\overline{V}_0 +0.72 S \leq 1356 m/s, \overline{V}_0 0.72 S \geq 1326 m/s).
 - b. "Representative Sample" and "Ballistic Sample" muzzle velocity standard deviation shall be less than or equal to 10 m/s.



Table III. Ballistic sample tests

| Test | Requirement paragraph |
|---------------------|-----------------------|
| Muzzle velocity | 3.2.1 · |
| Pressure | 3.2.2 |
| Action time | 3.2.3 |
| Smoke and flash | 3.2.4 |
| Fouling | 3.2.5 |
| Barrel erosion | 3.2.6 |
| Air space | 3.2.7 |
| Extreme temperature | 3.2.8 |
| Velocity uniformity | 3.2.1 |

NOTES:

- (a) Failure of the propellant to comply with the requirements of 3.1 or 3.2 shall be cause for rejection of the lot subject to testing of a second sample for the characteristic(s) in which failure occurred. The second test shall be made using the original sample, provided sufficient propellant remains. If additional propellant should be required, it shall be taken from the same boxes of propellant from which the initial "Representative Samples" were obtained. Failure of the second sample to comply with the requirements of the characteristic(s) under test shall be cause for rejection of the lot. The above provisions for testing of a second sample shall apply to the second and subsequent production lots. Accept/reject decision for first production lot and first article sample shall be based upon results of initial test only, and no second tests shall be permitted.
- (b) Velocity and pressure may be fired either separately or simultaneously, as prescribed in the appropriate inspection equipment list.
- (c) Performed by the procuring activity only.

Failure of the propellant to comply with the criteria of the uniformity test shall be cause for rejection of the lot subject to testing of a second sample. The second test shall be made using propellant from the original container in which sample failure occurred in the initial test. The second sample shall consist of 20 rounds. The criteria shall remain the same. Failure of the second sample to comply with the criteria of the uniformity test shall be cause for rejection of the lot.

- 4.3.3.3 Packing and marking inspection. Inspection of packing and marking to determine compliance with the requirements of 5.1 and 5.2 shall be as prescribed by the procuring activity (see 6.2).
- 4.3.4 Inspection equipment. All tests shall be made using equipment listed on the applicable inspection equipment list.
 - . 4.4 Test methods and procedure.
- 4.4.1 Chemical composition and physical properties. The applicable tests shall be performed in accordance with the procedures set forth in MIL-STD-286.
- 4.4.2 Ballistics. Ballistic tests listed in 4.3.3.2 shall be performed in accordance with AMCR 715-505 or TECP 700-700, as applicable, and methods developed specifically for the 25mm cartridge and the following.
- 4.4.2.1 Loading of test cartridges. The propellant sample selected in accordance with 4.3.2 shall be used to load test cartridges (see 6.3) with the charge weight established to obtain the specified average corrected velocity. When once established for a particular propellant lot, this charge weight may not be varied while the same lot is being tested. The test cartridges to be used for any velocity and pressure tests shall be loaded by a method capable of maintaining propellant charge weight uniformity ±0.1 g.
- 4.4.2.2 Extreme temperature. The tes: cartridges shall be conditioned and fired as indicated in table II and 3.2.8. Characteristic(s) applicable to the cartridge under test shall be tested in accordance with 4.4.2.
 - PREPARATION FOR DELIVERY
 - 5.1 Packing.
- 5.1.1 Level A (worldwide shipment and/or long term storage). Unless otherwise specified by the contracting officer (s_e 6.2), the propellant shall be packed in clean airtight containers conforming to Drawings 76-4-46, 76-4-56, F.7549033, or C.9256486.

- 5.1.1.1 Container integrity verification. Immediately prior to packing, containers listed in 5.1.1 snall be subjected to an internal pressure of 0.5 to 1.0 pounds per squara inch (psi) by a method satisfactory to the procuring activity. A water manometer shall be assembled in the system. A drop of 0.7 inch or more on the manometer in 15 seconds shall be cause for rejection and the container removed from the lot.
 - 5.1.2 Level B. Packing shall be as specified in 5.1.1.
- 5.1.3 Level C (CONUS shipment and/or short term storage). Unless otherwise specified by the procuring activity, the propellant snall be packed in standard commercial containers acceptable by common or other carrier for safe transportation to the point of delivery, at the lowest cost.
 - 5.2 Marking.
- 5.2.1 Levels A and B. The containers shall be sealed and marked in accordance with Drawings 20-4-77, 8858577, or 8858848. Markings shall also include the date of manufacture of propellant (month and year).
- 5.2.2 Level C. Containers shall be marked on the top and side with the same markings as required for the top and side of the box shown on Drawing 8858848. Markings shall also include the date of manufacture of propellant (month and year).
- 5.2.3 Special marking. All packed containers (level A, B, or C) shall have a printed label affixed to the side with the following information:

NOTICE

AFTER FIVE YEARS FROM DATE OF MANUFACTURE, APPROVAL BY THE RESPONSIBLE ENGINEERING AGENCY IS REQUIRED PRIOR TO THE LOADING OF THIS PROPELLANT INTO SMALL ARMS AMMUNITION.

- 5.3 Palletization. All level A shipments shall be palletized in accordance with instructions furnished by the procuring activity. Palletization is not required for level B or C shipments.
 - 6. NOTES
- 6.1 Intended use. Propellants procured under this specification are intended to be used in ammunition for the 25mm bestmaster weapon.

- 6.2 Ordering data. Procurement documents should specify the following:
 - a. Title, number, and date of this specification.
 - b. Applicable technical data package.
 - c. Provisions for the supply of the following, when applicable:
 - (1) Test equipment.

- (2) Production cartridges.
- (3) Production components.
- (4) Reference cartridges.
- (5) Rε ference propellant,
- d. Applicable packing container (see 5.1).
- e. Whether inspection of packing and marking is required and, if so, pertinent details (see 4.3.3.3).
- f. Provision for the submission of acceptance inspection reports containing propellant description sheets and ballistic acceptance test results for each lot of propellant presented to the procuring activity.
- 6.3 Definition of appropriate test cartridge. The appropriate test cartridge for all propellant acceptance tests shall be the same caliber, type, and model for which the propellant is intended and shall be assembled from components manufactured under production conditions as follows:
 - a. Propellant under test.
 - b. Primed cartridge case.
 - c. Projectile as applicable.
 - d. Case-to-projectile crimp to meet required buller pullilevels.

The test cartridge shall also be waterproofed and crimped as specified on the appropriate cartridge drawing.

ENGINEERING ORDER

| • | • • | | | | THE I | NFORMATION CONTAINED HEREIN SHALL SED FOR GOVERNMENT PURPOSES ONLY |
|---|--|---|----------------------------------|-----------------------------|---|---|
| | ENGINEERING C33179 SHEET ORDER NO. C33179 OF 1 | CCC CHAIRMAN DATE REC. ND. | | INCORP BY DATE CHECKED DATE | | |
| | PROGRAM BUSHMASTER ORIGINATOR 9-12-77 CHECK APPR | 64/6 30PV (//2/1) 37NE33 0ATE | DATE DETAIL ASSY | RECOMMENDED DISPOSITION | | |
| | | AFFECTED BAP-1 | **ETT | NO. REQUIRED | 1 | |
| | LEASE | LEASE FFECTIVITY 1 & SUBQ | ENGINEERING DEPT. ENGRG SERVICES | MEXT ASSEMBLY | | |
| | m LIMITED RELEASE | | τοντουξη | TITLE CHG | PROPELLANT, CARTRIDGE, - 25 MM, ARMOR PIERCING - TRACED | |
| | Communications Corporation Astronutrons Division Ford Road Newport Beach, California 92903 | 4 L L L L L L L L L L L L L L L L L L L | CEMALDE CHANGE | ENGINEERING Document no. | ADMS567895 PROPI 25 M | 64 |

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पुरुष्ण पुरुष पुरुष्ण कर्या कर्य THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

AFPENDIX A-3

Special Request Order of Propellant Manufacture

אנירת בוד - - דוב הדינץ

RADPORT :

La complete

RAUI CAD, VINCUUM 21141

10 NOV 1977

SARRA-EN '

Manager Hercules Incorporated Radford Army Ammunition Plant Radford, Virginia 24141

Dear Sir:

Reference is made to a meeting held at this installation on 2 November 1977, concerning the 25mm Bushmaster Work Program (PE-559).

Within funds available under PE-359, Propellant for 25mm Bushmaster, authority is granted to produce the following propellant lots:

| ' • | Pounds | <u>L/D</u> | MC Coating, * percent |
|-----|--------|------------|--|
| а. | 2000 | 1.1 | (a) 1000 lbs, 2.30% (b) 1000 lbs, 1.70% |
| ь. | 2000 | 1.3 | (c) 1 / lbs to be determined (d) 1.00 lbs at a later date |

^{*} Select final (a) and (b), and (c) and (d) from preliminary coating and firing (Mann Gun) and closed bomb (a) and (b) to be blendable.

The following process changes from lots PE-559-7 and PE-559-8 apply:

- a. K,SO4 reduced to 0.50 percent.
- b. Nitrogen content high side of spec. No (13.20%).
- c. Water Dry adjustment.

Sincerely yours,

CHARLES E. FLYNN Contracting Officer's Representative

THE INFORMATION COMPAND NERS IN SAME. YOUR SECRET THEMSENDED FOR COMPANDED TO THE COMPAND TO THE COMPAND THE COMPAND THE COMPAND TO THE COMPAND THE C

APPENDIX A-4-

AS 2013532A

Product Specification for 25-mm APDS-T Propellant

1. SCORE

1.1 Scope. This specification covers propellant for use in 25mm cartridges, APDS-T, M791.

2. APPLICABLE DOCUMENAS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids, or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-A-2550 - Ammunition, General Specification for

MIL-N-244 - Nitrocellulose

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-109 - Quality Assurance Terms and Definitions

MIL-STD-286 - Propellants, Solid: Sampling, Fxamination and Testing

MIL-STD-1168 - Lot Numbering of Ammunition

DRAWINGS (See 6.10)

9256486

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND

| | (Modified M24 Box for Smokeless Powder) |
|---------|--|
| 7549033 | - Container, Metal, Universal, M25 for Propellant and Explosives, Assembly and Details |
| 20 / 27 | 'Barbina and Markina of Book Book Book Book Book Book Book B |

- Container, Packing PA 54, Wood with Metal Liner

20-4-77 - Packing and Marking of Box, Packing, for Smokeless
Powders

| 76 4 46 | - Pax, Packing, Mctal Liner (Copper), M24, for Sackeless Towder |
|--------------|---|
| 76 4-56 | - See, Telks of the Shod, M17 for Stilliese Powders |
| 8898577 , | - Marking Diagram and Scaling of Container, Motal, Universal, 125 for Shipping of Projetlant |
| 8853848 | - Marking Diagram and Sealing of Metal Lined Wooden Packing Boxes for Shipment of Propellant |
| 12013217 . | - Case, Cartridge, Primed |
| 12013536 | - Projectile Subassembly, Traced |
| 12013533 | - Cartridge, 25mm, APDS-T, M791 |
| 12013535 | - Propellant, 25mm, APDS-T |
| IEL-12013535 | - Inspection Equipment List for Propellant, APDS-T |

PUBLICATIONS

FIGHTING VEHICLE SYSTEMS

AS12013566 - 25mm Ammunication Ballistic Test Methods

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

- 3.1 <u>General</u>. The propellant shall be in accordance with Drawing (Dwg.) 12013535 referenced specifications, publications, and other requirements specified herein.
- 3.2 Manufacturing process. The propellant shall be manufactured by a process approved by the contracting officer, and no deviations from that process shall be made without his prior approval (see 6.4).
- 3.3 First article inspection sample. This specification makes provision for a first article inspection sample. Unless otherwise specified by the contracting officer, a first article inspection sample is required (see 4.4 and 6.3).
- 3.4 Chemical composition and physical properties. The finished propellant shall comply with the requirements specified on Dwg. 12013535.

- 3.4.1 Rigrocallulose. Ritrocallulose recovered from the rework of propelus or new attrocallulose with the nitrogen content not fully meeting the requirements of ML-N-244 may be used in lieu of, or in combination with complying pitrocallulose. Propellant so manufactured shall comply with all the ical, physical, and ballistic requirements.
- 3.5 Mallistics. The propollant, when laided into a tyle troops test cartridges in accordance with Dwg. 12013533, shall comply with the following requirements.
- 3.5.1 Muzzle velocity. The average projectile makele velocity of the sample cartridges conditioned at 18° to 24°C shall be 1350 ±15 meters per second (m/s). The sample standard deviation shall not exceed 10 m/s.
- 3.5.2 Pressure. The average chamber pressure of the sample cartridges, conditioned at 18° to 24°C, plus three standard deviations of chamber pressure, shall not exceed 454 megapascals (MPa). The average chamber pressure of the sample cartridges, when functioning at any individual temperature from -54° to 71°C, plus three standard deviations of chamber pressure, shall not exceed 436 MPa. (Pressure shall be measured with a piezoelectric type pressure transducer or equivalent.)
- 3.5.3 Action time. The action time of the sample cartridges shall not exceed 5.5 milliseconds (ms) at any cartridge temperature from -54° to 71°C.
- 3.6 Air space. The propellant charge weight required to achieve the ballistic requirements of 3.5 shall result in an air space in the Primed Cartridge Case (Dwg. 12013217) which shall permit the insertion of the Projectile (Dwg. 12013536) into the charged case without any vibration or tamping to cause compaction of the propellant charge.
 - 4. QUALITY ASSURANCE PROVISIONS
- 4.1 Terms and definitions. Quality assurance terms and definitions shall be in accordance with MIL-STD-109.
- 4.2 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

- 4.3 Classification of impeditions. The in paction requires ants specified business classified as follows:
 - 1. First afficle inspection (see 4.4).
 - 2. Quality conforming impaction (see 4.5).
 - 4.4 First article sample inspection.
- 4.4.1 First article sa ple. The first article sample shall be taken from the first production lot and the sample shall be sabaitted in accordance to contract requirements (see 6.3). The sample shall be manufactured using similar equipment, processes, and procedures as will be used in production. Identification shall be in accordance with MIL-STD-1168.
- 4.4.1.1 Examination and test. The tests listed in Table I shall be performed on the first article sample in accordance with the test methods prescribed in 4.6. Except as otherwise specified, tests shall be conducted with samples at 20° ±10°C. Approval will be based upon examination and test of the sample as specified in Table I. Sample formation shall be as specified in 4.5.2.
- 4.4.1.2 First article sample rejection. Failure of the sample to comply with requirements of the drawings and specifications shall result in sample disapproval. Determination as to acceptability of any firs article sample shall be based upon results of initial tests only and no second tests shall be permitted on that first article. The acceptance/rejection criteria for the first article sample shall be as specified in Table I. All first article units shall be inspected 100 percent for critical defects.
 - 4.5 Quality conformance inspection.
- 4.5.1 Submission of product. 'The product shall be submitted in accordance with MIL-STD-105.
- 4.5.1.1 Lot. A lot shall consist of a uniform blend of propellant manufactured by one manufacturer, in one unchanged process, in accordance with the same drawings and drawing revisions, and the same specification and specification revision.

TABLE I. First article inspection.

| | Sample size | | | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | |
|-------------------------------|-------------|-------|------|--------------------------------------|-------------------|
| Examination or test <u>5/</u> | -54°C | · · · | 71°C | Requirement Paragraph | Test paragraph |
| Charical and physical 2/3/ | | | | 3.4 | 4.6.1 |
| Muzzle velocity 4/ | 100 | 100 | 100 | 3.5.1 | 4.6.2 |
| Pre sure 4/ | 100 | 100 | 100 | 3.5.2 | 4.6.2 |
| Action time $4/$ | 100 | 100 | 100 | 3.5.3 | 4.6.2 |
| Air space 3/ | | 20 | | 3.6 | 4.6.3 |

MOTES:

- 1/ Tolerance on ammunition conditioning temperature ±3°C except when otherwise indicated.
- 2/ Sample size shall be as specified in MIL-STD-286.
- 3/ Test performed on "Composite Sample".
- $\overline{4/}$ Test performed on 20-round groups on each of the five "Representative Samples". Pressure, velocity, and action time tests may be performed on the same sample.
- 5/ If any individual group of samples fails to meet the applicable requirement, the first article shall be rejected.
- 4.5.1.2 Lot identification. Each packed ammunition lot shall be identified in accordance with applicable drawings and MIL-STD-1168, supplemented as directed by the procuring activity.
- 4.5.2 <u>Sampling</u>. Random representative samples shall be taken by random selection of one container from each identifiable increment of the lot. A random sample of five containers shall be selected from these representative samples. From each container selected, a sample shall be taken such that the aggregate quantity shall be sufficient for the required tests. These samples shall be poured into clean containers, immediately closed with a hermetically tight seal and identified as "Representative Sample" with a label showing the

container number from which the sample was taken, the lot number, propellant no conclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Prior to conducting lot accept noe tests, these samples shall be premitted to attain room temperature; then equal portions sufficient to take the required quantity of a composite sample shall be taken from each "Mapaiso matrice Sample" and blooded. This composite sample shall be placed in containers, i mediately closed with a hermetically tight seal, and identified respectively as "Composite Sample". These containers shall be further identified by the container numbers from which the composite sample was taken, the lot number, propellant no enclature, packing date, accomfacturer, canufacturing plant, and total weight of the lot as packed. Both the "Composite Sample" and the "Representative Sample" shall be used to perform the tests as specified in Tables I and II.

- 4.5.3 Test. The tests listed in Table II shall be performed on each propellant lot in accordance with the test methods prescribed in 4.6. Unless otherwise indicated tests shall be conducted with samples at 20° ±10°C. Sample size and acceptance criteria for each test shall be as specified. Only propellant sampled in accordance with 4.5.2 shall be used in the tests. The combining of tests is permitted.
- 4.5.3.1 Unlisted firing defects. The lot shall be suspended and referred to the contracting officer for disposition if a malfunction or casualty not covered by this specification occurring in any firing test indicates that the product is unsuited for the purpose intended.
- 4.5.3.2 Packing and marking inspection. Inspection of packing and marking to determine compliance with the requirements of 5.1 shall be as prescribed by the procuring activity.
- 4.5.4 <u>Inspection equipment</u>. Inspection Equipment List No. IEL-12013535 identifies the applicable Inspection Equipment List required to perform examination and tests prescribed herein. The provisions of MIL-A-2550 shall apply.
 - .4,6 Test methods and procedures.
- 4.6.1 Chemical composition and physical properties. The applicable tests shall be performed in accordance with the procedures set forth in MIL-STD-286.
- 4.6.2 <u>Ballistics</u>. Ballistic tests shall be performed in accordance with AS12013566 as applicable, and the following:
- 4.6.2.1 Loading of test cartridges. The propellant samples selected in accordance with 4.5.2 shall be used to load test cartridges with the charge weight established to obtain the required ballistics. The variation in established charge weight between each group of "Representative Samples" shall not exceed 2.0 grams. The test cartridges shall be loaded by a method capable of maintaining propellant charge weight uniformity of plus or minus 0.1 gram, for the selected charge weight.

TABLE II. Quality conformance inspection.

| | Sample size | | | | | |
|----------------------------|-------------|---------|--------------|--------------------------|-----------|--|
| | Tela | peratur | e <u>1</u> / | N | Test | |
| Empaination or test 5/ | -54°C | 21°C | 71°C | Requirement paragraph | paragraph | |
| Chemical and physical 2/3/ | | | | 3.4 | 4.6.1 | |
| Muzzle velocity 4/ | 100 | 100 | 100 | 3.5.1 | 4.6.2 | |
| Prousure 4/ | 100 | 100 | 100 | 3.5.2 | 4.6.2 | |
| Action time 4/ | 100 | 100 | 100 | 3.5.3 | 4.6.2 | |
| Air space 3/ | | 20 | • | 3,6 | 4.6.3 | |

NOTES:

- 1/ Telerance on ammunition conditioning temperature ±3°C except when otherwise indicated.
- 2/ Sample size shall be as specified in MIL-STD-286.
- 3/ Test performed on "Composite Sample".
- 4/ Test performed on 20-round groups on each of the five "Representative Samples". Pressure, velocity, and action time tests may be performed on the same sample.
- 5/ Failure of the propellant to comply with the requirements shall be cause for rejection of the lot subject to testing or a second sample for the characteristic(s) in which failure occurred. Failure of the second sample to comply with the requirements for the characteristic(s) under test shall be cause for rejection of the lot.
- 4.6.2.2 Velocity correction factor. A correction factor of 0.19 m/s per meter shall be applied to the recorded velocity at the measured range to obtain muzzle velocity.

4.6.3 <u>Air space</u>. The propellant shall be poured into a primed cartridge case in accordance with MIL-STD-286, Method 508.1.2. Insert the projectile into the case both until it is completely seated without any vibration or toging of the components.

5. PACKING

- 5.1 Packing level A. (Worldwide shipment and/or long term storage.) . Unless otherwise specified by the contracting officer, the propollant shall be packed in clean airtight containers conforming to Pravings 76 4-46, 76-4-56, 9756486, or 7549033.
- 5.1.1 Immediately prior to packing, containers listed in 5.1 shall be subjected to an internal pressure of 1/2 to 1 pound per square inch by a method ratisfactory to the contracting officer's representative. A water manometer shall be assembled in the system. A drop of 0.7 inch or more or the manometer in 15 seconds shall be cause for rejection and the container removed from the lot.
 - 5.2 Packing level B. Packing shall be as specified in 5.1.
- 5.3 Packing level C. (CONUS shipment and/or short term storage.) Unless otherwise specified by the contracting officer, the propellant shall be packed in standard commercial containers acceptable by common or other carrier for safe transportation to the point of delivery, at the lowest cost.

5.4 Marking.

- 5.4.1 Levels A and 2. The containers shall be sealed and marked in accordance with Drawings 20-4-77, 8858577, or 8858848. Markings shall also include the date of manufacture of propellant (month and year).
- 5.4.2 Level C. Containers shall be marked on the top and side with the same markings as required for the top and side of the box shown on Drawing 8858848. Markings shall also include the date of manufacture of propellant (month and year).
- 5.4.3 Special marking. All packed containers (level A, B, or C) shall have a printed label affixed to the side with the following information:

NOTICE

AFTER FIVE YEARS FROM DATE OF MANUFACTURE, APPROVAL THE RESPONSIBLE ENGINEERING AGENCY IS REQUIRED PRIOR LOADING OF THIS PROPELLANT INTO SMALL ARMS AMMUNI ...

- 6. NOTES
- 6.1 Intended use. Propellants precored under this specification are intended to be used in 25.55 APDS-T accountion.
- 6.2 Ordering data. Invitation for bids and contracts or orders should specify the following:
 - 6.2.1 Firle, number, and date of this specification.
 - 6.2.2 Place of inspection, if not at place of manufacture.
 - 6.2.3 First article sample requirements (see 3.3, 4.4, and 6.3).
 - 6.2.4 Detailed packing and marking instructions (see Section 5).
- 6.2.5 Provisions for the supply, maintenance and disposition of Government furnished inspection equipment for acceptance inspection purposes.
- 6.2.6 Provisions for the submission and approval of the manufacturing process changes (see 3.2).
- 6.2.7 Provisions for the inclusion of MIL-STD-1167, Ammunition Data Cards, on DD Form 1423, Contract Data Requirements List.
- 6.3 First article inspection sample. The procurement agency may waive the requirement for a first article inspection sample if the contractor has recently demonstrated his ability to produce this item.
- 6.4 <u>Process deviation</u>. A process deviation is defined as a change in the approved basic method of manufacture, or an operational change which may alter the metallurgical or physical properties of the item.
- 6.5 AQL's. The optional use of AQL values for either individual defects or classes of defects, with individual major defect limitation, is intended to minimize inspection agency administrative burden which might result from an exclusive assignment of individual defects AQL's. The option also permits flexibility where sampling inspection for acceptance is integrated into the manufacturing process.
- 6.6 <u>Computations</u>. Standard deviation. Where computation of a sample standard deviation is specified for determination of lot acceptance, the method of computation will be:

$$S = \sqrt{\frac{\sum (x_i - \overline{x})^2}{(n-1)}} \text{ or equivalent}$$

!here:

 $X_i = each individual value$

X = sample acithmetic mean

n = sample size

- 6.7 Combining tests. Tests may be performed concurrently on the sample cartridge provided that the test results are not affected by this procedure to minimize testing costs.
- 6.8 Submission of inspection equipment designs for approval. Submit equipment designs as required to Program Manager, Fighting Vehicle Systems, ATTN: DECPM-FVS-PA, Warren, MI 48090. In request letter of submittal, state contractor contract number, specification number, item nomenclature, and classification of defect or test paragraph.
- 6.9 Submission of results of contractor-conducted examinations and tests. Unless otherwise specified by the contracting officer, the contractor should forward requested records of examinations or tests to Program Manager, Fighting Vehicle Systems, AITN: DRCPM-FVS-PA, Warren, MI 48090.
- 6.10 <u>Drawings</u>: Drawings listed in Section 2 of this specification under the heading US Army Armament Research and Development Command (ARRADCOM) may also include drawings prepared by, and identified as, Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal, or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under the cognizance of ARRADCOM.

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APPENDIX A-5

-AS12013532B

Product Specification for 25-mm Cartridge, APDS-T, M791

1. SCOPE

1.1 Scope. This specification covers propellant for use in 25mm cartridges, APDS-T, M791.

2. APPL CABLE DOCUMENTS

2.1 <u>Issues of documents</u>. The following documents of the issue in effect on date of invitation for bids, or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

HILITARY

HTL-A-2550 - Ammunition, General Specification for

KIL-N-244 - Nitrocellulose

· STANDARDS

MILITARY

HIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

MIL-SID-109 - Quality Assurance Terms and Definitions

MIL-STD-286 - Propellants, Solid: Sampling, Examination and Testing

MIL-STD-1168 - Lot Numbering of Ammunition

DRAWINGS (See 6.10)

US ARMY ARMAMEN? RESEARCH AND DEVELOPMENT COMMAND.

9256486 - Containe Packing PA 54, Wood with K tal Liner (Modifi M24 Rox for Smokeless Powder)

7549033 - Containez, Matal, Universal, M25 for Propellant and Explosives, Assembly and Details

20-4-77 - Packing and Marking of Box, Packing, for Smokeless Powders

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| 76-4-46 | - Box, Packing, Metal Liner (Copper), M24, for Smokeless Powder |
|-----------------------|---|
| 76-4-56 | - Box, Packing, Metal-Wood, M17 for Smokeless Powders |
| . 885857 ⁷ | - Marking Diagram and Sealing of Container, K cal, Universal, M25 for Shipping of Propellant |
| 88 58848 | - Marking Diagram and Sealing of Metal Lined Wooden Packing Boxes for Shipment of Propellant |
| 12013217 | - Case, Cartridge, Primed |
| 12013536 | - Projectile Subassembly, Traced |
| 12013533 | - Cartridge, 25mm, APDS-T, H791 |
| 12013535 | - Propellant, 25mm, APDS-T |
| TEL-12013535 | - Inspection Equipment List for Propellant, APDS-T |

PUBLICATIO IS

FIGHTING VEHICLE SYSTEMS

AS12013566 - 25mm Ammunication Ballistic Test Methods

_(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

- 3.1 General. The propellant shall be in accordance with Drawing (Dwg.) 12013535 referenced specifications, publications, and other requirements specified herein.
- 3.2 <u>nanufacturing process</u>. The propellant shall be manufactured by a process approved by the contracting officer, and no deviations from that process shall be made without his prior approval (see 6.4).
- 3.3 First article inspection sample. This specification makes provision for a first article inspection sample. Unless otherwise specified by the contracting efficer, a first article inspection sample is required (see 4.4 and 6.3).
- 3.4 Chemical composition and physical properties. The finished propellant shall com, y with the requirements specified on Dwg. 12013535.

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- 3.4.1 <u>Mitrocellulose</u>. Nitrocellulose recovered from the rework of propellants or new nitrocellulose with the nitrogen content not fully meeting the requirements of MIL-N-244 may be used in lieu of, or in combination with, complying nitrocellulose. Propellant so manufactured shall comply with all chemical, physical, and ballistic requirements.
- 3.5 <u>Ballistics</u>. The propellant, when loaded into sample APDS-T test cartridges in accordance with Dwg. 12013533, shall comply with the following requirements.
- 3.5.1 <u>uzzle velocity</u>. The average projectile muzzle velocity of the sample cartridges conditioned at 18° to 24°C shall be 1350 ±15 meters per second (m/s). The sample standard deviation shall not exceed 10 m/s.
- 3.5.2 Pressure. The average chamber pressure of the sample caltridges, conditioned at 18° to 24°C, plus three standard deviations of chamber pressure, shall not exceed 454 megapascals (MPa). The average chamber pressure of the sample cartridges, when functioning at any individual temperature from -54° to 71°C, plus reg standard deviations of chamber pressure, shall not exceed 496 MPa. ...essure shall be measured with a piezoelectric type pressure transducer or equivalent.)
- 3.5.3 Action time. The action time of the sample cartridges shall not exceed 5.5 milliseconds (ms) at any cartridge temperature from -54° to 71°C.
- 3.6 Air space. The propellant charge weight required to achieve the ballistic requirements of 3.5 shall result in an air space in the Primed Cartridge Case (Dwg. 12013217) which shall permit the insertion of the Projectile (Dwg. 12013536) into the charged case without any vibration or tamping to cause compaction of the propellant charge.
 - 4. QUALITY ASSURANCE PROVISIONS
- 4.1 Terms and definitions. Quality assurance terms and definitions shall be in accordance with MIL-STD-109.
- 4.2 Responsibility for inspection to use the specified in the contract or purchase order, the support is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed secessary to assure supplies and services conform to prescribed requirements.

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- 4.3 Classification of inspections. The inspection requirements specified berein are classified as follows:
 - 1. First article inspection (see 4.4).
 - 2. Quality conformance inspection (see 4.5).
 - 4.4 First article sample inspection.
- 4.4.1 Virst article sample. The first article sample shall be taken from the firs. production lot and the sample shall be submitted in accordance to contract requirements (see 6.3). The sample shall be manufactured using similar equipment, processes, and procedures as will be used in production. Identification shall be in accordance with MIL-STD-1108.
 - 4.4.1.1 Examination and test. The tests listed in Table I shall be perferred on the first article sample in accordance with the test methods prescribed in 4.6. Except as otherwise specified, tests shall be conducted with samples at 20° ±10°C. Approval will be based upon examination and test of the sample as specified in Table I. Sample formation shall be an specified in -.5.2.
 - 4.4.1.2 First article sample rejection. Failure of the sample to comply with requirements of the drawings and specifications shall result in sample disapproval. Determination as to acceptability of any first article sample shall be based upon results of initial tests only and no second tests shall be permitted on that first article. The acceptance/rejection criteria for the first article sample shall be as specified in Table I. All first article units shall be inspected 100 percent for critical defects.
 - 4.5 Quality conformance inspection.
 - 4.5.1 Submission of product. The product shall be submitted in accordance with MIL-STD-105.
 - 4.5.1.1 Lor. A lot shall consist of a uniform blend of propellant manufactured by one manufacturer, in one unchanged process, in accordance with the same drawings and drawing revisions, and the same specification and specification revision.

TABLE I. First article inspection.

| • | . Sa | mple siz | e e | | |
|---------------------------|-------|----------|------|-----------------------|-------------------|
| | Ter | perature | 1/ | | |
| Examination or test 5/ | -54°C | 21°C | 71°C | Requirement paragraph | Test paragraph |
| Chemica ad physical 2/ 3/ | | • | | . 3.4 | 4.6.1 |
| Muzzle velocity 4/ | 50 | 50 . | 50 | 3.5.1 | 4.6.2 |
| Pressure 4/ | 50 | 50 | 50 | 3.5.2 | 4.6.2 |
| Action time 4/ | 50 | 50 | 50- | 3.5.3 | 4.6.2 |
| Air space 3/ | | · 20 | | 3.6 | . 4:6.3 |

NOTES:

- 1/ Tolerance on ammunition conditioning temperature 23°C except when other-wise indicated.
- 2/ Sample size shall be as specified in MIL-STD-286.
- 3/ Test performed on "Composite Sample".
- 4/ Test performed on 10-round groups on each of the five "Representative Samples". Pressure, velocity, and action time tests may be performed on the same sample.
- 5/ If any individual group of samples fails to meet the applicable requirement, the first article shall be rejected.
- 4.5.1.2 Lot identification. Each packed ammunition lot shall be identified in accordance with applicable drawings and MIL-STD-1168, supplemented as directed by the procuring activity.
- 4.5.2 <u>Sampling</u>. Random representative samples shall be taken by random selection of one container from each identifiable increment of the lot. A random sample of five containers shall be selected from these representative samples. From each container selected, a sample shall be taken such that the aggregate quantity shall be sufficient for the required tests. These samples shall be poured into clean containers, immediately closed with a hermetically tight seal and identified as "Representative Sample" with a label showing the

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container number from which the sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Prior to conducting lot acceptance tests, these samples shall be permitted to attain room temperature; then equal portions sufficient to make the required quantity of a composite sample shall be taken from each "Representative Sample" and blended. This composite sample shall be placed in containers, immediately closed with a hermetically tight seal, and identified respectively as "Composite Samp". These containers shall be further identified by the container numbers from which the composite sample was taken, the lot number propellant nomenclature, packing date, manufacturer, manufacturing plant, and otal weight of the lot as packed, both the "Composite Sample" and the "Representative Sample" shall be used to perform the tests as specified in Tables I and II.

- 4.5.3 Test. The tests listed in Table II shall be performed on each propellant lot in accordance with the test methods prescribed in 4.6. Unless otherwise indicated tests shall be conducted with samples at 20° ±10°C. Sample size and acceptance criteria for each test shall be as specified. Only propellant sampled in accordance with 4.5.2 shall be used in the tests. The combining of tests is permitted.
- 4.5.3.1 Unlisted firing defects. The lot shall be suspended and referred to the contracting officer for disposition if a maltunction or casualty not covered by this specification occurring in any firing test indicates that the product is unsuited for the purpose intended.
- 4.5.3.2 Packing and marking inspection. Inspection of packing and marking to determine compliance with the requirements of 5.1 shall be as prescribed by the procuring activity.
- 4.5.4 Inspection equipment. Inspection Equipment List No. TEL-1201353; identifies the applicable Inspection Equipment List required to perform examination and tests prescribed herein. The provisions of MIL-A-2550 shall apply.
 - 4.6 Test methods and procedures.

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- 4.5.1 Chemical composition and physical properties. The applicable tests shall be performed in accordance with the procedures set forth in MIL-STD-286.
- 4.6.2 Ballistics. Ballistic tests shall be performed in accordance with AS12013566 as applicable, and the following:
- 4.6.2.1 Loading of test cartridges. The propellant samples selected in accordance with 4.5.2 shall be used to load test cartridges with the charge weight established to obtain the required ballistics. The variation in established charge weight between each group of "Representative Samples" shall not exceed 2.0 grams. The test cartridges shall be loaded by a method capable of maintaining propellant charge weight uniformity of plus or minus 0.1 grum, for the selected charge weight.

TABLE II. Quality conformance inspection.

| | Sample size Temperature 1/ | | | | | |
|--------------------------|-----------------------------|------|------|--------------------------|-------------------|--|
| | | | | • | | |
| Examination or test 5/ | -54°C | 21°C | /1°C | Requirement paragrapa | Test paragraph | |
| Chemical: physical 2/ 3/ | . | | | 3.4 | 4.6.1 | |
| Muzzle velocity 4/ | : 50 | . 50 | 50 | 3.5.1 | 4.6.2 | |
| Pressure 4/ | 50 | 50 | 50 | 3.5,2 | 4.6.2 | |
| Action time 4/ | 50 | 50 | 50 · | 3.5.3 | 4.6.2 | |
| Air space 3/ | • | 20 | | 3.6 | 4.6.3 | |

NOTES:

- 1/ Tolerance on ammunition conditioning temperature 13°C except when othervise indicated.
- 2/. Sample size shall be as specified in MIL-STD-286.
- 3/ Test performed on "Composite Sample".
- 4/ Test performed on 10-round groups on each of the five "Representative. Samples". Pressure, velocity, and action time tests may be performed on the same sample.
- 5/ Failure of the propellant to comply with the requirements shall be cause for rejection of the lot subject to testing of a second sample for the characteristic(s) in which failure occurred. Failure of the second sample to comply with the requirements for the characteristic(s) under test shall be cause for rejection of the lot.
- 4.6.2.2 <u>Velocity correction factor</u>. A correction factor of 0.19 m/s per meter shall be applied to the recorded velocity at the measured range to obtain muzzle velocity.

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4.6.3 Air space. The propellant shall be poured into a primed cartridge case in accordance with MIL-STD-236, Method 508.1.2. Insert the projectile into the case mouth until it is completely seated without any vibration or tamping of the components.

5. PACKING

- 5.1 Packing level A. (Worldwide shipment and/or long term storage.)
 Unless otherwise specified by the contracting officer, the propellunt shall be packed in clean airtight containers conforming to Drawings 76-4-46, 76-4-56, 9256486. : 7549033.
- 5.1.1 Immediately prior to packing, containers listed in 5.1 shall be subjected to an internal pressure of 1/2 to 1 pound per square inch by a mathod satisfactory to the contracting officer's representative. A drop of 0.7 inch or more in 15 seconds shall be cause for rejection and the container removed from the lot:
 - 5.2 Packing level B. Packing shall be as specified in 5.1.
- 5.3 Packing level C. (CONUS shipment and/or short term storage.) Unless otherwise pecified by the contracting officer, the propellant shall be packed in standard commercial containers acceptable by common or other carrier for all transportation to the point of delivery, at the lowest cost.

5.4 Marking.

- 5.4.1 Levels A and B. The containers shall be sealed and marked in accordance with Prawings 20-4-77, 8858577, or 8658848. Markings shall also include the date of manufacture of propellant (month and year).
 - 5.4.2 Level C. Containers shall be marked on the top and side with the same markings as required for the top and side of the box shown on Drawing 8858848. Markings shall also include the date of manufacture of propellant (month and year).
 - 5.4.3 Special marking. All packed containers (level A, B, or C) shall have a printed label affixed to the side with the following information:

NOTICE

AFTER FIVE YEARS FROM DATE OF MANUFACTURE, APPROVAL BY THE RESPONSIBLE ENGINEERING AGENCY IS REQUIRED PRIOR TO THE LOADING OF THIS PROPELLANT INTO SMALL ARMS AMOUNITION.

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- 6. NOTES
- 6.1 Intended use. Propellants procured under this specification are intended to be used in 25mm APDS-T ammunition.
- 6.2 Ordering data. Invitation for bids and contracts or orders should specify the following:
 - 6.2.1 Title, number, and date of this specification.
 - 6.2.2 Pl of inspection, if not at place of manufacture.
- 6.2.3 First article sample requirements (see 3.3, 4.4, and 6.3),
 - 6.2.4 Detailed packing and marking instructions (see Section 5).
- 6.2.5 Provisions for the supply, maintenance and disposition of Government furnished inspection equipment for acceptance inspection purposes.
 - 6.2.6 Provisions for the submission and approval of the manufacturing process changes (see 3.2).
 - 6.3 First article inspection sample. The procurement agency may waive the requirement for a first article inspection sample if the contractor has recently demonstrated his ability to produce this item.
 - 6.4 Process deviation. A process deviation is defined as a change in the approved basic method of manufacture, or an operational change which may alter the chemical or physical properties of the item.
 - 6.5 AQL's. The optional use of AQL values for either individual defects or classes of defects, with individual major defect limitation, is intended to minimize inspection agency administrative burden which might result from an exclusive assignment of individual defects AQL's. The option also permits flexibility where sampling inspection for acceptance is integrated into the manufacturing process.
 - 6.6 Computations. Standard deviation. Where computation of a sample standard deviation is specified for determination of lot acceptance, the method of computation will be:

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$$\sqrt{\frac{\sum (x_i - \overline{x})^2}{(n-1)}}$$
 or equivalent

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Where:

X, " each individual value

I - sample arithmetic mean

m - sample size

- 6.7 Combining tests. Tests may be performed concurrently on the sample cartric's provided that the test remains are not affected by this procedure to min se testing costs.
- 6.8 Submission of inspection equipment designs for approval. Submit equipment designs as required to Program Manager, Fighting Vehicle Systems, ATTN: DRCPM-FVS-PA, Warren, MI 48090. In request letter of submittal, state sometractor contract number, specification number, item nomenclature, and classification of defect or test paragraph,
- 6.9 Submission of results of contractor-conducted examinations and tests.
 Unless otherwise specified by the contracting officer, the contractor should forward requested records of examinations or tests to Program Manager, Fighting Vehicle Systems, ATTM: DRCPM-FVS-PA, Warren, MI 48090.
- 6.10 <u>Drawings</u>. Drawings listed in Section 2 of the specification under the heading IS Army Armament Research and Development Command (ARRADCOM) may also include drawings prepared by, and identified as, Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal, or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under the cognizance of ARRADCOM.

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ROCK SEAND, REINOIS, #1201 12013535 5/14/79 10/11/24 1/20/00 DAYE 502.3, without Š פינו וכספו יפואו אס 19204 RELEASE PER ED C 48073 DESCRIPTION .1062 (mm) . .0943 (mm) .0.019 ± 0.002 REVISIONS SCALE NONE 0.9 to 1.3 0.93 min 15 ± 5 20 mx œ SEE ED C 30690 SEE EO (51210 7 . . . X PHYSICAL ATTRIBITES AND VARIABLES Ingth-to-Dissite Ratio Web Difference I of web atd day Diameter-to-Perferation i. the Advisor: Web, Average, Inch CENERAL 1 Bula Density, gm/ce PROPELLANT CHEMICAL AND PHYSICAL REQUIREMENTS (2) 4 MF TONE LTE Ø lameter (D) in. 1110010 length (L) in. CATE Configuration PROPRIETARY MOTE TOTAL SOURCE AND MINEMS AND MINEMS AND LOCAL SOURCE AND L DAAA09-75-C-2048 BY FORD AEROSPACE & COMMUNICATIONS CORP., AERONUTRONIC DIVISION, NEWPORT BEACH, CALIF, 92663. WAL PROTECTIVE FINISH CONTRACT PURNISHED UNDER U.S. GOVT. Test Method 2111-570-7868 2007 C110 BAP-1 Conting: Exact persentings and remainder of formula may. be moditied for upitudized balllatic quality. 0.9 ± 0.4 0.5 ± 0.3 1.9 %celeal APPLICATION Landadat \$4.1.2 IC-5 minimiza 1043.2 For information only and mare prom Wife or programme with 12013533 MERE ASSY 40 mintere . All sources must comply with drawing requirements and specification ASIZO13512, MIL-H-244, Type I, Grada Q. Sercification. MIL-P-193 MIL-P-193 'TL-K-19719 VOTES: UNLESS OTHERWISE &PECIF;ED MIL-0-155 Color Change - Minutes to Salmon Pink Manard Classification Markings (\$41)40 1. Specification Mil-STD-2868 appiles. POUR AND RESIDUAL INCRUDENTS Hethyl Vielet Stability Relative Quichness, % Relative Force, % Closed Borb Tree or +90°C Meldus Solvente Dist and Fereign Hatter Capinates - hrs. Fotone_se Sulphate Fathyl Centralite (*) TOTAL AMSWE Form 4038, 29 Jul 69 4 Au Test at 135.5 C Explouives Hexared Classification Tutal Vulatiles . Merocollulote Kytroscopicity stability crosp Dipheny losted Ingredient (*)Cuecing: Holature CHOCKL S 38 ۵ U 89 8 4

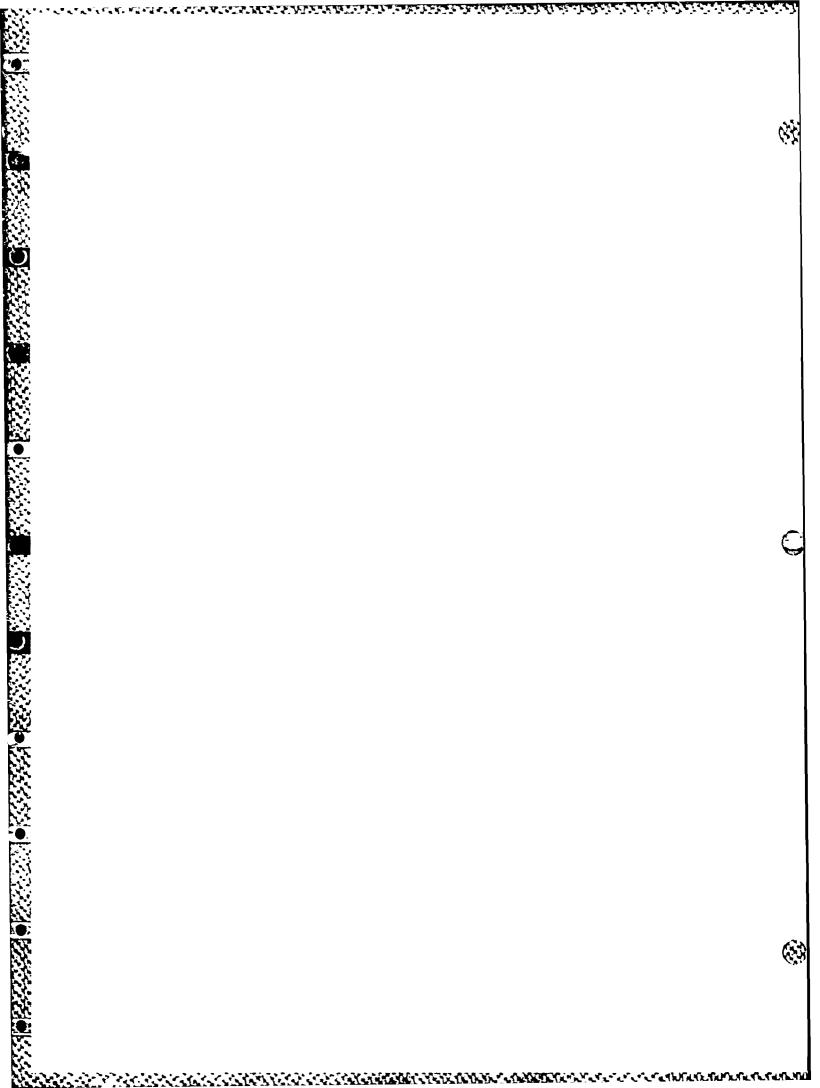
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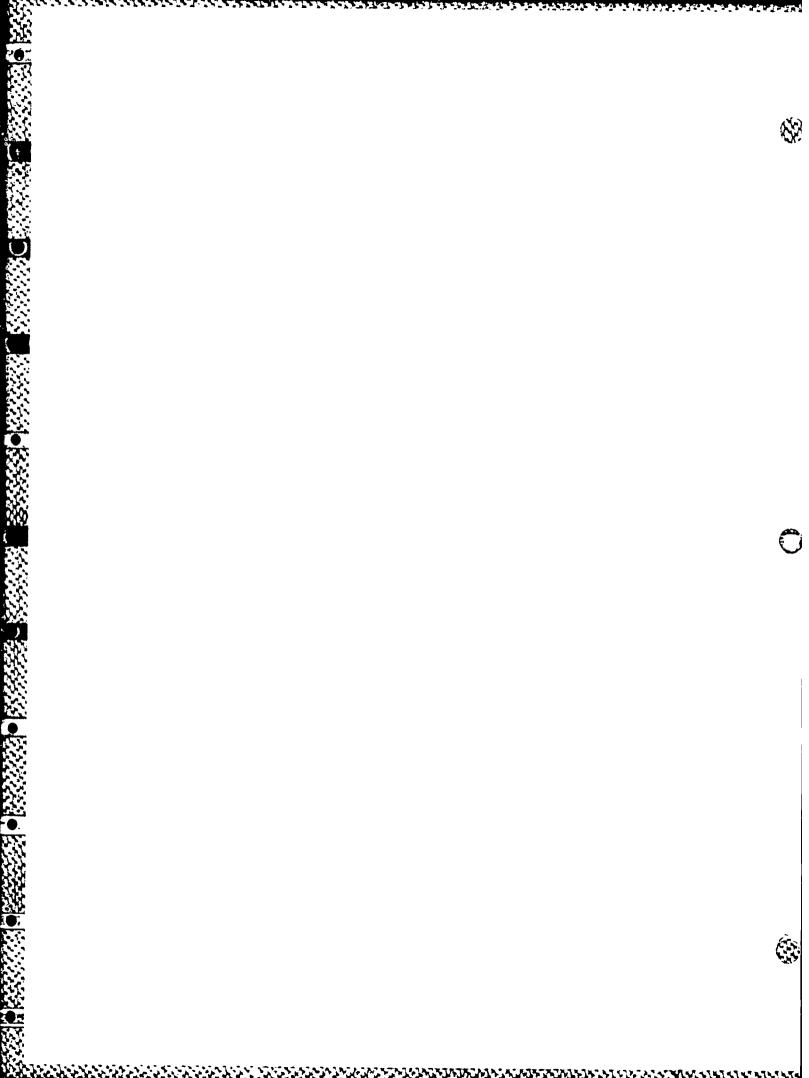


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APPENDIX B

DESCRIPTION OF 25-MM MANN GUN TEST



D.R. 8074

TECHNICAL DISCUSSION

HE Propellant Evaluation

The HE propellants were tested with Oerlikon components Lot 21-6-74. The Oerlikon test slug weight was 177 grams. The HE test slugs used with Olim propellants were 187 grams. Propellants A1, A2, B1 and B2 were initially tested at 75 grams charge weight. At this low charge weight, propellant B1 gave too high a pressure and seemed to be too fast for the HE rounds. B2 was too slow. Testing of A1 and A2 was continued at increasingly higher charge weights. At 35 grams charge weight, A1 gave the desired velocity of 3669 ft/sec. at a pressure of only 51.8 kpsi. Full case charge weight for the HE configuration is 92 grams. A1 was blended in various proportions with the slower propellant A2 at increased charge weights in order to reduce the air space. There was no problem meeting the velocity requirements within the pressure limitations.

Table I gives test data for propellants tested in HE configurations using Oerlikon test slugs, weight 177 grams. Further testing will be done with the 187 gram banded test slug for comparison with Olin propellant performance.

AP Propellant Evaluation

Propellants A1, A2, B1 and B2 were tested in AP components at 75 grams charge weight. At this charge weight, propellant B1 gave velocity of 4200 ft/sec. at pressure of 42.3 kpsi. Further testing of B1 propellant at increasingly higher charge weights was carried out until full case was achieved. At full case charge weight (100 grams), the pressure attained (58.3 kpsi) exceeded the maximum limit of 56.6 kpsi, but the velocity (4466 ft/sec.) was slightly below the desired velocity of 4500 ft/sec.

Propellant B1 was then blended with the slower propellants A1 and A2 in order to reduce the high pressure peak and to spread out the base of the P-T curve. None of these blends attained the desired velocity within the maximum pressure limit, but were not too far off. Table II gives ballistic data for propellants tested in AP components. The physical and chemical data for these propellants is given in Table III.

It is to be noted here that the weight of the Oerlikon AP test slugs with plastic sabot used in this evaluation (OE Lot 12-12-74) was only 121.5 grams, whereas the weight of our test slug is 135 grams.

D.R. B074 Page 2

CONCLUSIONS

Radford propellant Al, by itself, or when blended with propellant A2 appears to be satisfactory for the HE rounds. This will be confirmed by further testing using the 187 gram banded test slug. At full case charge weight of 100 grams, propellants Bl, by itself, and/or when blended with A2 did not make velocity with the lighter (121.5 gram) projectile. Further development and testing of the AP-T propellant will have to be performed using the heavier (130 gram) projectile.

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TABLE II

RADFORD PROPELLANT EVALUATION

(AP Configuration)

| | | 01 | | | | • |
|-----|--------------------|-----------------------------|----------------|------------------------|----------------|--------------|
| | Propellant | Charge Weight (Grams) | t _A | P _m kpsi | P c kpsi | V ft/sec. |
| 1. | A1 | 75 | 5.25 | 4.01 | 40.4 | 3580 |
| 2. | A2 | 75 | 6.03 | 3.91 | 26.3 | 3186 |
| 3. | B1 | 75 . | 5.37 | 4.01 | 42.3 | 420G |
| 4. | B2 | 75 | 6.35 | 3.71 | 22.1 | 3029 |
| 5. | В1 | 80 | • . | 4.13 | 30.3 | 3547 |
| 5. | B1 | 85 | 5.71 | 4.53 | 37.1 | 3860 |
| 7. | B1 | 90 | 5.49 | 4.88 | 43.1 | 3947 |
| 8. | BI | 95 | 5.31 | 5.17 | 49.2 | 4241 |
| 9. | B1 | 97 | 5.07 | 5.36 | 52.1 | 4338 |
| 10 | B1. | 98 | 5.19 | 5.47 | 53.4 | 4358 |
| 11. | B1 | 100 | 4.91 | 5.36 | 58.3 | 4466 |
| 12. | B1 - 75 A1 - 25 | 100 | 4.47 | • | 58.7 | 4426 |
| 13. | B1 - 75 A2 - 25 | 100 | 4.59 | - | 7 53.6 | 4338 |
| 14. | B1 - 85 A2 - 15 | 100 | 4.56 | - | 57.0 . | 4370 |

Redford Propellant: Full Case Charge Weight = 100 grams for AP configuration

A? Components: OE Lot 12-12-74 Slug Weight = 121.5

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CHEMICAL AND PHYSICAL DATA - RADFORD PROPELLANTS

| | <u>A-1</u> ' / | <u>A-2</u> | <u>B-1</u> | B-2 |
|-------------------------------|----------------|------------|------------|---------|
| Nitrocellulose, % (13.15%N) | 94.29 | 92.48 | 94.82 | 92.82 |
| Diphenylamine, % | 0.55 | 0.57 | 0.52 | 0.51 |
| Potassium Sulfate, % | 0.79 | 0.85 | 0.79 | 0.76 |
| Methyl Centralite, % | 4.26 | 5.95 | 3.74 | 5.80 |
| Graphite % | 0.11 | 0.15 | 0.13 | 0.11 |
| 'ix-Pour alv, % | 0.44 | 0.63 | 0.62 | 0.75 |
| Ik wenszty, t/cc | 0.9892 | 0.9805 | 0.9933 | 0.9985 |
| Pivsical rensions | | | | |
| Mean Length, Inches | 0.067 | 0.067 | 0.067 | 0.067 |
| Mean Dutside Diameter, Inches | 0.052 | 0.052 | 0.055 | 0.055 |
| Mean Perforation, inches | 5.0043 | 0.0043 | 0.0042 | 0.0042 |
| Mean Web, inches | 0.9235 | 0.0235 | 0,0257 | 0.0257 |
| Theoretical Performance | | • | | |
| Flame Temperature (K) | 2810 | 26/1 | 2725 | 2749 |
| Impetus (fc/.5/1b) | 329,000 | 219,000 | 324,000 | 325,000 |

APPENDIX C

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PRODUCTION ENGINEERING INVESTIGATION (PEI-559-4)

PEI 559-4

SPECIAL OPERATING INSTRUCTIONS

I. MATERIALS MANAGEMENT

A. Materials Control

Following is a list of materials required for the manufacture of 25mm propellant:

| Nitrocellulose (13.15%N) | MIL-N-244 Type I, Grade C |
|--------------------------|------------------------------|
| Diphenylamine (DPA) | MIL-D-98 |
| Potassium Sulfate | MIL-P-193 |
| Graphite | MIL-G-155 |
| Methyl Centralite* | MIL-M-19719 |

^{*}Must be ground - 97 percent minimum to pass a 70 mesh screen.

II. PROPELLANT DEPARTMENT

Type Propellant: 25mm

Approximately 1000 pounds - 4 mixes will be required.

| Composition | Specification | Percent by Weight | Weight, pounds |
|--|------------------------------|-------------------|----------------|
| Nitrocellulose* (13.15 ± 0.05%N Cotton Linters | MIL-N-244 Type I, Grade C | 100.00 | 348.0 |
| Diphenylamine (DPA) | MIL-D-98 | 1.00** | 3.5 |
| Potassium Sulfate | MIL-P-193 | 1.00** | 3.5 |
| | | | 355.0 |

^{*} Use blend with N closest to 13.20 percent.

Nitrocellulose requirements are as follows:

Solubility

Acceptable Limits
40 to 49 percent

Fineness Final Blend:

Control: 95 to 105ml Accept: 90 to 110ml

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Final Blend: 490 to 550ml

Freeness

^{**} Based on nitrocellulose weight.

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| Acceptable Limits | 5 | its | i m | L | 1e | ab | ٥t | er | c | c | A | |
|-------------------|---|-----|-----|---|----|----|----|----|---|---|---|--|
|-------------------|---|-----|-----|---|----|----|----|----|---|---|---|--|

Solvents

- 92 pounds solvent per 100 pounds 326 pounds of solvent per mix dry weight of ingredients
- 65 parts ether per 100 parts solvents 212 pounds of ether per mix
- 35 parts alcohol per 100 parts 114 pounds of alcohol per mix solvents

A. Chemical Grind

Weigh ingredients as required in accordance with the following:

| Ingredient | Weight/Bag | Tolerance |
|-------------------|---|-----------------------|
| K2S04 | 3.5 lbs | ± 0.3 oz |
| DPA | 3.5 1bs | ± 0.3 cz |
| Graphite* | 2 1bs | ± 0.3 oz |
| Methyl Centralite | As determined and r Analytical Group | equested by Technical |

^{*}Graphite weight is based on 1000 pounds per batch.

B. <u>Nitrocellulose Area</u>

Supply a sufficient quantity of nitrocellulose (13.15% N linters) to produce approximately 1000 pounds dry weight of 25mm propellant.

C. Dehydration

1. Use General Operating Instructions and the following specific instructions:

| Number of blocks | 4 | |
|-------------------------------------|--------------------|--|
| Dry weight of NC per block | 87 | |
| Gallons of alcohol per block (min) | 17 | |
| Nominal dwell time, minutes | 1 | |
| Wet weight of individual block, lbs | 104 [±] 4 | |

2. Weigh dehy blocks and record individual block weights on flow card. Identify each mix by NC blend number and type of propellant.

D. Solvent Mix House

1. Use General Operating Procedures for preparing DPA with ether (mixed solvent). Mixture calculated weights of ingredients for preparation of one final mix charge and one solvent mix are as follows:

| Ingredient | | One Final Mix, pounds | One Solvent Mix (4-1/2 Mixes) |
|------------------------|-------|-----------------------|-------------------------------|
| Ether Diphenylamine | | 212.3 3.5 | 955.35 pounds 15.78 pounds |
| | TOTAL | 215.8 | 971.10 pounds |

2. A laboratory analysis must be performed on each tank of solvent mix. The laboratory sample must meet the following requirements:

| Ingredient | Percent Ingredient |
|---------------|--------------------|
| Diphenylamine | 1.02 to 2.22 |
| Ether | 97.38 to 99.38 |

E. Final Mixer (mixer temperature 50° maximum)

- 1. Build alcohol to 114 pounds and add the alcohol to the mixer.

 The alcohol add weight is determined by subtracting the dry nitrocellulose weight from the total wet weight of the dehydrated blocks and subtracting the difference from 114 pounds.
- ?. If there is no alcohol build, there must be a minimum of 10 pounds added to the mixer.
- 3. With the mixer in operation, gradually add 348 pounds of nitro-cellulose (split blocks) to the mixer.
- 4. Mix for 4 to 5 minutes.
- 5. a. Standard Method . Allow 216 1 pound of mixed solvents to start flowing into the mixer.
 - b. Alternate Method Add 3.5 pounds (3 lbs 8 ozs ± 0.3 ozs) of DPA to 10 pounds of ether in a solvent boot. Stir the mixture with a wooden paddle until the DPA is discolved (approximately 1 minute). Add the slurry mix (DPA-ether) plus an additional 202 pounds of ether to the mixer.
- 6. Add one bag of K₂SO₄ (3.5 pounds) to the mix. Distribute the chemical evenly.

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- 7. Add 40 pounds of remix (strands, split press blocks, and heels) if available.
- 8. Close the 1id and mix for 25 minutes.
- 9. In minutes, minimum prior to discharging the mixer, an additional solvent add (ether/alcohol in a 2:1 ratio) may be made, as required, to produce propellant which will extrude within the desired pressure range. Record all solvent adds and exact mixing time on the flow card.
- 10. Continue mixing until a minimum mixing time of 40 minutes (time after the start of solvent mix addition) has occurred.
- 11. When the desired mix consistency has been obtained, pull the mix into aluminum tubs.
- 12. Charge the required amount of propellant into the macerator.
- 13. Macerate for a minimum of five minutes.
- 14. Pull the macerated propellant and deliver to the preblocker.

Alternate Mixer

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- 1. Produce 4 mixes using Beken-Mixer (double-wing) and current GOP.
- 2. Mix time will be 30 minutes or as specified by initiating engineer.

F. Preblocking, Macaroni, and Final Blocking

- 1. Preblocker Sufficient dwall time to make blocks for macaroni press.
- 2. Macaroni Use one 16-mesh screen.
- 3. Final Elocker 30 seconds (minimum) high pressure dwell time.

G. Press and Cutting House

| | <u>RAD-PE-559-6</u> |
|--------------------|---------------------|
| Type Press | Vertical |
| No. of Screens | 2 (16 and 40 mesh) |
| No. of Dies/Press | 49 |
| Die Dimensions | |
| Agate, inch | 0.080 inch |
| Pin, inch | 0.010 inch |
| No. of Pins | 1 |
| Extrusion Pressure | 2000-2800 |

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G. Press and Cutting House (cont'd)

RAD-PE-559-5

Type Cutter Small Arms

Green Length 0.071 ± 0.001 inch

Outer Web 0.086
Inner Web 0.086
Cutting Die 0.086
No. of Blades 56

Roll Size 1-1/2 plain

Gear Train 90 x 180 x 160 x 89

- 1. Dies (agates) must be QC inspected prior to use.
- 2. Adjustments may be necessary in the gear train and cutting dies to obtain correct dimensions.
- 3. Use water/alcohol mixture in dripolator on cutting machines.
- 4. Cutting machines must be kept in adjustment so as "tails" do not exceed 5 percent.
- 5. The lots must be properly identified and separated.

H. Solvent Recovery

Use General Operating Procedures.

- 1. Load the propellant into the Solvent Recovery tank at 35°C. Keep each lot separate.
- 2. Increase the temperature from 35° to 55°C over a 12-hour period and hold at 55 6°C for 34 hours (or until a solvent flow of 5 minutes or more is obtained).
- (SAMPLE)
 3. Obtain a one-quart sample from each lot after cycle is completed.

 Label the samples for residual solvent analysis and physical measurements.
 - 4. Transport to Water Dry.

I. Water Dry

- 1. Load propellant in Water Dry and cycle at 56° 62°C.
- 2. Water dry propellant for 10 days. Do not take off cycle.

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I. Water Dry (cont'd)

(SAMPLE)

- 3. Obtain a one-pound sample from each lot after 10 days of cycling. Label the samples for residual solvents and physical measurements.
- 4. Instructions for additional cycling will be given by initiating engineers based on residual solvent analysis. An additional one-pound sample for residual solvents only may be required if cycle time is increased.

J. Coating House

Coating will be in accordance with the following table:

| Granulation Lot RAD-PE- | Propellant* Coating Wet Weight Level,% | Weight of Methyl Cen- tralite/Ether Alcohol per Coating Blend | Weight of Ethyl Alcohol Pre-Wet/ Coating Blend | No. of Coating Blends |
|-------------------------|--|---|--|-----------------------------|
| 559-6 | 223 lbs (wet) 4.56 200 lbs (dry) | 11.0/17.0 lbs | 9.0 lbs | 5 |

Methyl centralite must be ground - 97 percent minimum to pass a 70 mesh screen

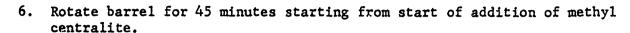
The first (pilot) blend will be sampled and tested for moisture, HOE and closed bomb before additional blends will be coated. Based upon these ballistic relits, the remaining propellant will be coated according to instructions given by R-QCIC.

Coating Technique

- 1. Charge wet propellant (200 pounds dry weight) and prewetting alcohol into coating barrel.
- 2. Start barrel rotation.
- 3. Bring temperature to 75 $^{+}$ 1°C (167 $^{+}$ 2°C).
- 4. Rotate for 15 minutes at temperature and stop barrel.
- 5. In accordance with the table above or RQCIC, place coating slurry tank in coating barrel opening and start barrel.

^{*}It will be necessary to determine the moisture content of the wet propellant from each granulation size. A representative sample (1 pint) will be taken from the bagged propellant and CC14 moisture determined in order to calculate proper dry propellant weight.

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- 7. Cool coating barrel to 40°C and cycle 10 minutes.
- 8. Wash propellant with cold water from coating barrel through trough and discharge into buggies.
- 9. Transport to air dry identified as lot RAD-PE-559-6.

K. Air Dry

- 1. Charge 2000 lb lot.
- 2. Maintain temperature of air at 54 ± 4°C (129 ± 7°F) for a sufficient time to obtain a moisture content range of 0.85% to 1.25%. Estimated time is 5 11 hours. A 20 minute M&V sample should be taken after five hours.
- 3. At the end of drying cycle, allow a minimum of one hour cool-down at 100 5 F with blowers running.
- 4. Upon completion of drying, send propellant sublots to Blending and Glazing in drop plug buggies.

L. Blending and Glazing

- 1. Charge lot into a blender barrel and rotate for 10 minutes (ungraphited).
- 2. Obtain a one-pint sample from each lot, label, and send to Chemical Laboratory for 20 minute M&V analysis.
 - a. If M&V results are within range of 1.00 to 1.30 percent, no adjustment is necessary.
 - b. If M&V results are less than 1.00 percent, the water add can be calculated by the following equation:

Pounds of
Propellant x 1.15 - M&V Results

1.00 = Pounds of water to add

3. After the moisture content has been adjusted, glaze prope'lant batch with 0.2 percent graphite using a 3-hour glaze cycle (2 pounds/1000 pounds)



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- 4. Screen propellant.
- 5. Pull lot into fiber drums and identify as lot RAD-PE-559-6.
- (SAMPLE) 6. Obtain a 10-pound sample from lot after screening has been completed. Label sample for gun, chemical, HOE, closed bomb, bulk density, hydroscopicity, and physical dimensions. Identify sample by proper designations.

M. Marking and Addressing

Marking and address is to be as follows:

One side: PROPELLANT EXPLOSIVE (SOLID) CLASS B 25mm GUN HE

LOT RAD-PE-559- 6

0.024" WEB SP GRAIN

150 LBS NET 161 LBS GROSS

4.2 CU FT PACKED ____

TO: AERONUTRONIC FORD CORPORATION

AERONUTRONIC DIVISION

SAN JUAN CAPISTRANO TEST FAC. SAN JUAN CAPISTRANO, CA. 92675

FROM: COMMANDER

RADFORD ARMY AMMUNITION PLANT RADFORD, VIRGINIA 24141 CONTRACT: DAAA-09-71-C-0329

III. TECHNICAL DEPARTMENT

A. Quality Control

- Monitor and inspect the propellant outlined under this PEI using Standard Inspection Procedure and Special Operating Instructions contained herein.
- Ensure that the propeliant is kept separated and properly identified at the cutting machine and in the powder buggies.

^{*}Insert as applicable.

February 28, 1977

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- And the own and paint bland, perform 4-shot RQ and RY tests at sure 1 12 and 1 1 and 1 instant density, 200cc closed bomb. Obtain suremanners 100 Wandooff int 117 1).

Comme advences:

making massing and physical engines on lot samples as outlined to the termony burging and feeting instructions table.

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SAMPLING AND TESTING SUMMARY

| Amount of Sample Tests Jdentification | 1 pound GC TV and 20' M&V PEI No., Lot No., or 1 pint | er 1 pound GC TV and Moisture PEI No., Lot No., ng or pint Date, Hours dried, lat "Water Dried", | l pint, 20' M&V GC TV ea sample | d 1 pound Moisture, HOE, RQSRF 1 pint, 20' M&V, GV TV PEI No., Lot No., Date ea sample "Pre-Glaze" 25mm | ot 10 pounds % Methyl Centralite PEI No., Lot No., Date, / Graphice Shift, Time, 25mm 3C 3v "Final Lot Acceptance 5 Hour May Sample" Bulk Density Physical Dimensione Gun Test Closed Bomb Hygroscopicity 2 DPA |
|---------------------------------------|---|--|---------------------------------|---|--|
| Frequency | l sample | Sample after water drying 10 days and at end of cycle. | 1 sample after 5 hours* | First Blend 1 sample | i sample lot |
| Where Sample Taken | Solvent Recovery | Water Dry | Afr Dry | Coating Blender Barrel | Final Screen House |
| Item SampleD | Solvent Content | Drying Time | Moisture Level | Coating Coating Each Lot (Ungraphited) | Finished Propellant |

*Additional samples may be required, depending on initial results.

APPENDIX D

"CLD METHOD"

PROCEDURE FOR COATING PROPELLANT FOR 25-MM

HE PROJECTILE

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PROCEDURE FOR CCATING PROPELIANT FOR 25 mm HE PROJECTILE

Ingredients:

Base Grain: Single perforated M10 formula with: Web = 0.022" - 0.024";

D/d = 6 - 10; and L/D = 1.1 - 1.5

Coating: Methyl centralite, per specification MIL-M-19719, ground to

pass 70 mesh screen

Coating Vehicle: Water

Coating Equipment:

"Sweetie" barrel, copper or stainless steal, with a hot water jacket. Barrel is rotated at 18 revolutions per minute.

Procedure:

- 1. Charge wet (=12 percent) propellant (100 1200 pounds, dry weight) to barrel while at ambient temperature.
- 2. Insert basket lined with 20-mesh screening into barrel opening and add to it ground methyl centralite in quantity necessary to effect the specified or desired coating level.
- 3. Commence barrel rotation and bring jacket temperature to 195 205°F (91 96°C).
- 4. Cycle at this temperature for 30 minutes.
- 5. Cover propellant with water so that propellant level is under water by at least six inches.
- 6. Steep (cycle) at 200 + 5°F (91 96°C) for six hours.
- 7. Cool (15 minutes) and wash propellant into buggies containing filters or load washed propellant onto drying trays.
- 8. Dry for 6 8 hours in tank air dry or forced air dry at 140°F (60°C).
- 9. Blend, glaze, and pack.

APPENDIX E

"NEW METHOD"

PROCEDURE FOR COATING PROPELLANT FOR 25-MM APDS-T PROJECTILE

PROCEDURE FOR COATING PROPELLANT FOR 25-17m APDS-T PROJECTILE

Ingredients:

Base Grain: 7-Perforated M10 formula with: Web = 0.018' - 0.019";

D/d = 11 - 15; and L/D = 0.9 - 1.5

Coating: Methyl centralite, per specification MIL-M-19/19

Coating Vehicle: Ethyl alcohol and water

Coating Equipment:

"Sweetie" barrel, copper or stainless steel, with a hot water jacket. Barrel is rotated at 18 revolutions per minute.

Procedure:

- 1. Charge water-dried propellant (100 1000 pounds, dry weight) that has been drained to <10 percent water into coating barrel.
- 2. Based on dry weight of propellant, bring water weight to 0.1 lb/lb, and add alcohol, 0.14 lb/lb. Bring rotating barrel jacket to 167 \pm 2°F (75 + 1°C).
- 3. Charge methyl centralite and alcohol coating slurry (quantity depends upon specified coating) to barrel contents over 5-minute period.
- 4. Rotate barrel and contents for 2 hours $(\pm 5 \text{ minutes})$ at previously stated temperature.
- 5. Cool barrel to room temperature for 15 minutes.
- 6. Wash propellant from coating barrel with cold water through chutes into buggles with sieves in bottoms.
- 7. Vater day for 48 hours to remove excess alcohol.
- 8. Dry 5 to 8 hours in tank air dry at 140° F $(60^{\circ}$ C)
- 9. Blend, glaze and pack.

APPENDIX F PROPELLANT DESCRIPTION SHEETS

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY LOT NUMBER PROPELLANT RAD-PEI-559-1 (S/L A-3) ACCEPTANCE MODEL ACCEPTANCE DASE SHEET 3 June 1976 PROOF FIRED SY PROVING GROUND MFGBY HERCULES INCORPORATED FIRING RECORD NUMBER RADFORD ARMY AMMUNITION PLANT PROJECTILE WEIGHT PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-71C-0329 TEMPERATURE OF POMOER TOU THA JUBSTORS CRACHATE 807 lbs WEIGHT OF LOT PROPELLANT DESCRIPTION 1.1 TYPE AVERAGE WEB SPECIFICATION DATED WITH REVISION DATED CHARGE WEIGHTS TOTAL INCREMENT WT PROJECTILE WEIGHT VELOCITY FT/SEC PRESSURE LBS/SQ IN INCH MENT NO. INCREMENT WT. 25mm HE Propellant Accepted for PE Project 559 THIS PROPELLANT LOT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION THE PROPELL ANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE COMPLETE AGOND OF PHOPELLING CHARGE TYPE PROJECT WT DRAWING DATE OF LAST REV THIS LOADING AUTHORIZATION EXPINES AFTER - WILL BE CONSIDERED. LAT WHICH TIME REBLENDING OF REASSESSMENT LOADING AUTHORIZATION ISSUED TO CHIEF QUALITY ASSURANCE DIVISION

| PRO | PELLANT D | ESCRIPT | TION SHI | ET | | |
|---------------------------------------|--|--------------------|---------------------------|----------------------|----------------|----------------|
| 118 Army 13AR- PET-559-1 | (S/I. A-3) or 19 76 c | emposition No. | _ 25mm HE | Propell | an f | |
| Manufactured at RADFORD ARMY | AMMUNITION PLANT RA | DEORD VA | | 807 lbs. | | |
| Compact No. DAAA09-71- | -C-0329 Date 6-30 | 0-71 Specification | M. COR Itr SAR | RA-IE, da | ted 13 | April_ |
| | | | | <u>76</u> | | |
| ACCEPTED BLEND N | UMBERS NITE | ROCELLULOSE | | | | |
| | | | Miltregen Content | KI Storen (65 5°C | 1 | (134 5°C) |
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| | | | Arerege 13.12 | | | |
| | | | <u> </u> | 1 | £ +2'0440 _ | |
| 0_92Paunds Solvent per Provid No | MANUFACTU E/Ory we ght ingredients Consisted | RE OF PROPI | ELLANT se Niconel end 25 | Panes ethe | F per 100 f | Paurda Salvard |
| Percentage Pem s to Whice | PROCESS-SOLVE | NT BECOVE | OV AND DOVING | | | ·we |
| F-0.0 | erature of SR Tank | | | | Coye | Hours |
| 1 cmpc | ink Temperature Inc | | | | | 12 |
| r | ent Recovery Time | | | | | 34 |
| 56 62 Water | Dry Period | | | | 10 | |
| | l Centralite Coat | ing Cycle | | | | 6 1/2 |
| 55 55 Force | ed Air Drving After | | | | | |
| PROPELLATE COMPOSITION | TESTS OF FI | | ELLAN I STABIL | TY AND PHYS.CA | L TESTS | |
| Nitrocellulose | Remainder | 92.14 | 12/ 596 | Form | | 501 |
| Diphenylamine | 0.5 to 1.25 | 0.62 | No Explosio | | C 40" | |
| Graphite | 0.4 max | 0.17 | Jean at Properions | 1 - 1 - 11 | مستلخة لسد | |
| Methyl Centralite | 4.50 to 5.00 | 4.56 | Heat of Fx | | | |
| Porassium Sulfate | 0.10 to 1.00 | 0.81 | cal/gm | N/A | | 346.1 |
| Total Volatiles Moisture and Volatile | $\frac{1}{2.35}$ max $\frac{1}{2.35}$ max $\frac{1}{2.35}$ | 1.70 | | | | |
| Residual Solvents | 1.10 max | 0.56 | | | i | ~ |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| CLUSED | ВОМВ | PROPELLA | NT DIMENSIONS | (incl.es) | | |
| | m of Gueness Force | | | (11101133) | Mean Veri | A ni nessa |
| Test | | | Specification Dis | Freehod | 5005 | Actual |
| | | Length (L) | | 0 0.07 9 | N/A | 7.65 |
| Stenderd | 100.00% 100.00% | Diameter (2) | | 0 0.0527 0 0.0053 | | 2.83 |
| Remarks | | Web Ave | | 5 0.0236 | CA | TES |
| | | | | | | 22/76 |
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| | | Wee Difference/ | | | | /1/76 |
| | i i | STE Dee in % | | | | /1/76 |
| | | 1.0 | | إستنسانسا | Coscribilion S | 73/76 |
| | | 1: | | 19.94 | | |
| Type of Packing Container | Fiber Drums | | | | | |
| Remarks This lot meets | s all specification | n_requiremen | nts. | | | ~ |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Contractor s Representative | | Service | Justing Laurence Paperson | telive | | |
| | | | | | | |
| R. A. Williams | · | J. E. | Bland | | | |

| PRO | PELLAN | JT D | 36 | CRIP | | ON | 51-13 | 57 | <u>C</u> | ORREC | TED | |
|--|---------------------|--|---------------|---------------------|--------------|---------------|---------------|---------------|--------------|------------|-------------|--------------|
| US Army Lot No. RAD-PEI-559- | 1 | . <u>9_76_</u> c | mpa | sition No. 25 | nun | AP Pro | <u>pellan</u> | <u>t</u> | | | | |
| (S/L B-3) | | | | | | | | | | <u> </u> | | , |
| Lanufactured of RADFORD ARMY A | C-O329 | LANT, RA | DEC | ORD VA | | Pocked Amer | 395 | POT | unds i | a ted | | |
| Comrect NoDAAAU9-/1-0 | V-00E3 | | | | | , | | | 1 197 | | | |
| ACCEPTED ALCOHOLING | | NITE | ROC | ELLULCS | = | | | سنت | | | | |
| A-15177 | MREKZ | | | | _ | *** | | | | | | |
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| | ature of | SR tank | du | ring loa | di | 20 | | | | | | |
| 35 55 SR Tan | k temperat | ture inc | re | ase peri | lod | | | | | | | 12 |
| <u> </u> | recovery | | | | | | | | | | | 34 |
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| | centralia | | _ | | | | | | ··· | | | 6 1/2 |
| | | | | HED PRO | PF | LAHT | | | | | _ | |
| PROPELLANT COMPOSITION | Percent formate | Perrent Dierante | | Dergent Mersured | | | STABILITY | AND | | | r | |
| Nitrocellulose | Remainder | | | 92.51 | | a- 701 1 | 2/ 5°C | | CC 40 | nuio nin | | Actual |
| Diphenylamine | 0.50 to | | | 0.67 | -: | No Exp | | | 5 hr | | | |
| Graphite | 0.40 ma. | | | 0.14 | | Farm of Prop | | | | | | |
| Methyl Centralite | 3.9 nom | ···· | | 3.88 | _ | Heat o | | osi | n, | | | |
| Potassium Sulfare | 0.10 to | | . | 0.89 | | cal | /gm | | N/ | Α | 86 | 2.7 |
| Total Volatiles | 2.35 max 1.00 + | 0.25 | | 0.18 | \dashv | | | | | | | · |
| Moisture & Volatiles Residual Solvents | 1.10 max | ــــــــــــــــــــــــــــــــــــــ | | 0.73 | | - | | | - | · | | |
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| Type of Packing Conto ner This lot meets a | | ication | TO | ari remen | 17.5 | | | | | | | |
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| *Description sheet is | amended to | reflec | t | that 200 |) D | ounds w | ere sh | ipp | ed to | | | |
| Aeronutronics Ford, a | | | | | | | | | | | | |
| future use. | | | | | | | | | | | | |
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| | | | | .1 | | • | | | | | | |
| R. A. Williams | | | | J. E. | B7: | ınd | - | | | | | |

*CORRECTED COPY THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY LOT NUMBER **WEAPON** PROPELLANT. RAD-PEI-559-1 (S/L B-3) ACCEPTANCE din MODEL ACCEPTANCE DATE SHEET 3 June 1976 PROOF FIRED BY PROVING GROUND MFGBY HERCULES INCORPORATED FIRING RECORD NUMBER RADFORD ARMY AMMUNITION PLANT AT PROJECTILE WEIGHT PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-71C-0329 TEMPERATURE OF POWDER STANDARD PROPELL ANT LOT 395 pounds WEIGHT OF LOT PROPELLANT DESCRIPTION TYPE M AVERAGE WEB WITH REVISION DATED SPECIFICATION DATED CHARGE WEIGHTS TOTAL INCREMENT WT. PROJECTILE WEIGHT VEL OCITY FT/SEC PRESSURE LBS/SQ IN. INCREMENT NO. INCREMENT WT. 25mm AP Propellant Accepted for PE Project 559 THIS PROPELLANT LOT IS ACCEPTED Belining Corrected copy issued to correct weight of lot. JAMÉS E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE APCY AND MODEL | COMPLETE ROUND OR PROPELLING CHARGE MODEL PROJECT WI **DRAWING** DATE OF LAST REV TYPE THIS LOADING AUTHORIZATION EXP!RES AFTER ... WILL BE CONSIDERED. -AT WHICH TIME REBLENDING OR REASSESSMENT LOADING AUTHORIZATION ISSUED TO

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CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY OT NUMBER PROPELLANT RAD-PE-559-3A ACCEPTANCE MODEL ACCEPTANCE DATE SHEET 14 December 1976 PROOF FIRED BY **PROVING GROUND** MFG BY HERCULES INCORPORATED FIRING RECORD NUMBER AT RADFORD ARMY AMMUNITION PLANT PROJECTILE **WEIGHT** PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-71C-0329 TEMPERATURE OF POWDER ٥ç STANDARD PROPELLANT LOT 105 pounds WEIGHT OF LOT PROPELLANT DESCRIPTION M TYPE AVERAGE WEB WITH REVISION DATED DATED SPECIFICATION CHARGE WEIGHTS TOTAL INCREMENT WT. PROJECTILE WEIGHT PFESSURE LBS/SQ IN VELOCITY FT/SEC INCREMENT NO. INCREMENT WT. Single-Base, Multiple Perf., Methyl Centralite Coated for 25mm AP-T Accepted for PE Project 559. THIS PROPELLANT LOT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE WE APON AND MODEL COMPLETE ROUND OR PROPELLING CHARGE TYPE CATE OF LAST REV PROJECT WT DHANING THIS LOADING AUTHORIZATION EXPIRES AFTER — WILL BE CONSIDERED. AT WHICH TIME REBLENDING OR REASSESSMENT LOADING AUTHORIZATION ISSUED TO CHIEF QUALITY ASSURANCE DIVISION

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THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY **WEAPON** LOT NUMBER PROPELLANT RAD-PE-559-3B ACCEPTANCE MODEL ACCEPTANCE DATE SHEET 14 Decmeber 1976 PROOF FIRED BY PROVING GROUND MFGBY HERCULES INCORPORATED FIRING RECORD NUMBER RADFORD ARMY AMMUNITION PLANT AT PROJECTILE **WEIGHT** PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-71C-0329 TEMPERATURE OF POWDER STANDARD PROPELL ANT LOT 105 pounds WEIGHT OF LOT PROPELLANT DESCRIPTION TYPE M AVERAGE WEB WITH REVISION SPECIFICATION DATED DATED CHARGE WEIGHTS TOTAL INCREMENT WT. PROJECTILE WEIGHT PRESSURE LBS/SQ IN. VELOCITY FT/SEC INCREMENT NO. INCREMENT WT. Single-Base. Multiple Perf., Methyl Centralite Coated for 25mm AP-T Propellant Accepted for PE Project 559. THIS PROPELLANT LOT IS ACCEPTED JAMÉS E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION

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| | | | | sed Borl | | | alla. | 15 max 1 Nom | | | 8.84 | | |
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| ype of Paca- temoras | ng Conteiner_ | One Dir | e tibe | ons are | containi from the | ng u | 100 pound ncoated b | as ne ase sto | and 5 po ock prope | ella | sampl nt. | e | |
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| Cantierter e 1 | | n - | **** | 1: | | | Gentrement | - | E River | | | | |
| | | K. A | Wil | ilams | | | ~! | <u>J.</u> | E. Blanc | | | | |

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY OT NUMBER PROPELLANT RAD-PE-559-4A ACCEPTANCE MODEL ACCEPTANCE DATE SHEET 14 December 1976 PROOF FIRED BY PROVING GROUND MFGBY HERCULES INCORPORATED FIRING RECORD NUMBER RADFORD ARMY AMMUNITION PLANT AT PROJECTILE WEIGHT PROJECTILE LOT NUMBER DAAA09-71C-0329 CONTRACT NUMBER TEMPERATURE OF POWDER CF STANDARD PROPELLANT LOT 105 pounds WEIGHT OF LOT PROPELLANT DESCRIPTION М TYPE AVERAGE WEB WITH REVISION DATED DATED SPECIFICATION CHARGE WEIGHTS TOTAL INCREMENT WT. PROJECTILE WEIGHT PRESSURE LBS/SQIN VEL CCITY FT/SEC INCREMENT WT. INCREMENT NO. Propellant, Single-Base, Miltiple Perf., Methyl Centralite Coated for 25mm AP-T Accepted for PE Project 55% THIS PROPELLANT LOT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSULANCE DIVISION. LOADING AUTHORIZATION THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE COMPLETE ROUND OR PROPELLING CHARGE JECCY CKA NOGABW TYPE MODEL DRAWING DATE OF LAST REV PROJECT WT THIS LOADING AUTHORIZATION EXPIRES AFTER — WILL BE CONSIDERED. AT WHICH TIME REBLENDING OR REASSESSMENT LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE CIVISION

| PROPELLANT D | ESCRIP | TION | SHEE | 7 | | |
|--|--|--------------------|--|--|---|-----------------|
| U 5 A-My Let No. RAD-PE-559-4A et 19 76 | Composition No. Pr | opellant,S | ingle-B | ase Mul | tiple | Perf., |
| Methyl Centralite Coated for | t_25.m_AE-X | | | | _ | |
| 14 perfectived of RADFORD ARMY AMMUNITION PLANT, R. 1. perfect to DAAAQ9:-71-C-Q329 Date 6-3 | AUFORD, VA. | COR I e | or | | dated | |
| I, persent No. DAMAY STITE USES Date US | 20-11_ Specifi also | 15 Jul | v 1976 | GGT TIPE | uareu_ | |
| ACCEPTED BLEND NUMBERS NIT | ROCELLULCIS | E | | | E | |
| C15031 | | Hitrogen Co | alese VI | lioren (65.3°C | Stabili | ly ({34.5°C) |
| | | Message | * | | *************************************** | (dins |
| | | L'mmum | | | M8 | |
| | | _annes _13 | -12 - 4 | <u>5</u> ± | - 30 | um |
| MANUCACT | URE OF PRO | DELL AUT | حلصد | | Espietion | W/1 |
| 0.92 Peurcs Seivent per Pound NC/Dry Weight Ingrediente Consiste | 75 | unes Alcohol and | <u> 65</u> | . Ether | , mer 100 | Pounds Selvent. |
| TEMPERATURES CO. DOMOFOS-SOLV | ENT RECOVE | RY AND DE | YING | | | TILLE |
| 35 55 Increase Temperature i | | | | | 5073 | Haura 12 |
| 49 61 Solvent Recovery | | | | | | 34 |
| 56 62 Water Dry | | | | | 15 | |
| 74 76 Coating Cycle 58 62 Post Coating Air Dry | | | | | | 1/2 |
| 58 62 Post Coating Air Dry | ······································ | | · | | | 16 |
| TESTS OF F | INISHED PRO | PELLANT | | | | |
| PROPELLANT COMPOSITION Constituent Fermale : Compositions | | | STABILITY (| | AL TESTS | Actual |
| Nitroceliulose Remainder | 95.75 | فبسبون وعصبه وعجيب | P.,134. | | | 60'+ |
| Nitrogen in Nitrocellulose 13.15 -0.05 | | No Expl | | | s Mi- | 5± |
| Dippenvlamine G.50 to 1.2 | | Farm at Prep | | | c | ylinder |
| Graphite 0.40 Max Methyl Centralite 3.0 Now | 2.45 | No. Per | coration | ıs | | 7 |
| Potassium Sulfate 0.10 to 1.0 | | | | | | |
| Total Volatiles 2.35 Max | 2.05 | Heat of | Explo- | | | |
| Moisture & Volatiles 1.00 ± 0.2 | | | cal/gm | | | 896 |
| Residual Solvents 1.10 Max Hygroscopicity 1.80 Max | 0.94 | | ······································ | | | |
| Hygroscopicity 1.80 Max Dust & Foreign Matter 0.10 Max | 1.42 | | | | | |
| Bulk Density, em/cc 0.940 to 1. | | | | | | |
| CLOSED BOMB | | ANT DIVENS | SIONS (inc | nes) | | |
| Lot Kumber Temp of Geighten Felenting Corce | | | | | Meen Yer | Dimensions |
| (1) RAD-PE-559-4A +90 106.64 99.75 (2) RAD-PE-559-4A +90 105.59 99.25 | T | Specification | 019 | Fireshod | 3205. | Actival * |
| (2) RAD-FE-559-4A +90 105 59 99 25 | D-mester (D) | | | 0.1250 0.0962 | | 2.73 |
| 100.00° 100.00° | | | | 0.0078 | | ATES |
| emerts : | veb* | | | | |] |
| | | 0.0185 Non | | <u> </u> | | 1/19/75 |
| | Outer | | | 0.0192 | Test Finishe | 1/19/75 |
| (1) Loading Density of 0.15 ym/cc | Innor | 15 max | _0.0310 ~36.19 | | | |
| (2) Loading Density of 0.2 gm/cc | of dep gamae | I Nom | 0.88 | | Describtion | 2/9/76 |
| 200 cc(Nom) Closed Bomb | 5 4 | 5 - 15 | 10,50 | | | /13/76 |
| 0 E21 1 | | | | | | |
| Type of Possing Contenter One fiber drum contain *Dimensions are from th | ing 100 pou | inds net ai | d 5 pou | nd sam | <u> </u> | |
| Apmerts Princers ore From th | e uncoared | nase stock | proper | iane. | | |
| This lot produced on a | best offer | t basis. | | | | |
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| Contractor o Representar sa | Corornagen | Guerry Assurance | Poprocontation | | | |
| D A 112112 | l | | | | | 1 |
| R. A. Williams | | <u> I E Plan</u> | 4 | | | |

| PROF | PELLANT | 1 | 54 GOVER | RNMENT PURPOSES | | | |
|--|----------------------------------|--|--|---|---|--------------------------------------|--------------------|
| | PTANCE | | | | | -559-4B | |
| S | HEET | · M | ODEL | | | ANCE DATE | |
| | | | | OOT EIRED BY | 14 Dec | ember 1976 | NC CROUND |
| | ES INCORPORATE D ARMY AMMUNIT | | 510 | OOF FIRED BY ING RECORD NUM | BER | PROVI | NG GROUND |
| | | | PRO | OJECTILE LOT NU | | EIGHT | |
| CONTRACT NUMBER | DAAA09-71C 105 pounds | | TEN | MPERATURE OF P | OWDER | οέ | |
| WEIGHT OF LOT . | | | | DESCRIPTION | | | |
| TYPE | M | FNOFE | LLANI | DESCRIPTION | | | |
| AVERAGE WEB | DAT | E 0 | | WITH REVISION | | DATED | |
| SPECIFICATION | UA, | <i>ED</i> | | WIT A REVISION | | DATED | • |
| | | C | HARGE | WEIGHTS | | | |
| INCREMENT NO. | INCREMENT WT. | TO INCREM | TAL ENT WT. | PROJECT IL I WE I GHT | VELOCI FT'SE | TY PR | ESSURE S/SQ IN. |
| | Single-Base, PE Project 5 | | Perr., | Methyl Centr | alize Coated | for 25mm A | ?-T. |
| THIS PROPELL ANT | LOT IS ACCEPTED |) | | | TARGO, EL D | T AND | |
| | | | | | JASTEN P N | | |
| | | | | | JAMES E. B | SSURANCE DIV | ISION |
| THE PROPELI BELON EXCE | LANT LOT DESCRI | BED ABOVE TIES ARE SP | MAY BE U | THOR:ZATION USED IN LOADING LY ALLOTTED F | CHIEF QUALITY A | UNITION ITEM | |
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| ~ | | PRO | ELLAN | IT DE | SCRIP | 710 | 3: PSC | | T | | |
|-------------------|----------------------|----------------|-------------------------|---------------------------------------|----------------------|------------|--------------|--------------------|----------------|-----------------|----------------|
| U.S. Army Lo | RAD- | PE-559- | 4B •• | , <u>76</u> c. | magairies No. P | ropel | | | | Multir | le Perf |
| | Meth | <u>yl Cent</u> | <u>ralite Coa</u> | ted for | 25mm AP-T | | | | | | |
| | RADFOR | D ARMY | MMUNITION F | LANT. RAI | DFORD VA | Per | ctrd Amount | 10 | 5 DDA 75 | 1-4-1 | |
| Contract Ha. | UAA | 109-11- | C-0329 | _ 0ate <u>D-3C</u> | CL_Specificati | | 5 July | | KKA-IE | dated | |
| - | Accepte | D BLEND NU | wef94 | NITR | OCELLULOS | | | | | | |
| C | 15031 | <i>3</i> | | | | | Hirogen Cont | - K | Storen (65.5*) | Sinhi | Hy (134 5°C) |
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| **** | | | МД | NUFACTU | RE UF PRO | PELLA | NT | | | £1819814 | <u></u> |
| 0.92 | Pounds Solvent | per Pound NC | Dry Weight Ingredi | ents Consisting | 35 | runda Alco | nel and | 55 | Eth | er per 10 | Pounde Selvers |
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| TEMPERAT From | To | | | | NT RECOV | | | | | Dey | |
| 35 | 55 | | ase temper | | om loadin | g to | cycle 1 | level | | | 12 |
| 49 | 61 | Solve Water | nt Recover | у | | · | | | | 16 | 34 |
| _56 | 76 | | ng Cycle | | | | | | | | 1/2 |
| 58 | 62 | | Coating Ai | r Dry | | | | | | 1 | 16 |
| | | | | | | | | | | | |
| PROPE | LLANT COMPO | SITION | | | IISHED PRO | | ANT . | STABILITY | AND PHYSIC | AL TESTS | |
| | Constituent | | Rercent Formula | i Purcumo i interance | Percent Medeut 6. | | | | | mula | Actual |
| | ellulose | | Remainder | · · · · · · · · · · · · · · · · · · · | 94.3 | | | | C No C | | _60'±_ |
| | en ir NC | | 12.15 0.50 to | ± 0.05 | 13.1 | | explos | | | s_Min | _5+ |
| <u> </u> | <u>vlamine</u> | | 0.40 | Max | 0.2 | | o Perfe | | | | Cylinde: 7 |
| | Central | ite | 5.0 | Nom | 3.8 | | U.FEI.II | иасти | | | |
| Potass | ium Sulf | ate | 0.10 to | 1.00 | 1.0 | 1 | | | | | |
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| | re & Vol al Solve | | 1.10 | ± 0.25 | 0.6 | | eat of cal/s | | sion | | 854 |
| | copicity | | 1.80 | Max | 1.3 | | <u> </u> | | | - | |
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| Bulk P | ensity. | | | o 1.050 | 0.9 | | | | | | |
| 1 | | OSED E | 1 1000 | Ferce | PROPELL | ANT. | DIMENS! | ONS lin | (casa) | Mean V | iristien in % |
| Test (1) | RAD-PE-5 | | | 97.34 | | | lication | Dre | Fireshed | 91 M941 2005 | Actuar* |
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| Pemeras | | | | | Web± Avg | U.U. | 85 Non | 0262 | 10 0127 | Perked 1 | 1/19/76 |
| | | | | | Outer | | | | 0.0192 | 5079-60 | 11/19/7 |
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| | R. A. | William | <u>s</u> | | | J. E | . Blan | d | | | |
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THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY WEAPON OT NUMBER **PROPELLANT** RAD-PE-559-5A ACCEPTANCE MODEL ACCEPTANCE DATE SHEET 25 May 1977 PROCF FIRED BY PROVING GROUND HERCULES INCORPORATED MEGBY FIRING RECORD NUMBER AT RADFORD ARMY AMMINITION PLANT PROJECTILE WEIGHT PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-77-C-4007 TEMPERATURE OF POWDER OE. STANDARD PROPELLANT LOT 109 pounds WEIGHT OF LOT PROPELLANT DESCRIPTION М TYPE AVERAGE WEB DATED WITH REVISION DATED SPECIFICATION CHARGE WEIGHTS PRCJECTILE WEIGHT TOTAL INCREMENT WT. VELOCITY FT/SEC PRESSUPE INCREMENT WT. INCREMENT NO. LBS/SQ IN 25mm MP Propellant for AP Projectile Accepted for FE Project 559 THIS PROPELLANT LOT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE I COMPLETE ROUND OR PROPELLING CHARGE **WEAPON AND MODEL** TYPE MODEL PROJECT NT **DRAWING** DATE OF LAST REV THIS LOADING AUTHORIZATION EXPIRES AFTER _ WILL BE CONSIDERED. AT WHICH TIME REBLENDING OR REASSESSMENT 1 LOADING AUTHORIZATION ISSUED TO

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| U S Army Li | RAD- | PE-559-5 | SA | c | empesil | hen Me | 2. | 5mm MP Pr | opella | nt | for A | P Pro | jec | tile |
| | | | | | | | | | | | | | | |
| | |) ARMY AI 9-77-C-4007 | MUNITION | | | | | | tter S | TD | S. | dated | | |
| Centract 40. | טאיאט | 7-77-C-4007 | - | Dete 4-1- | -// | Specificat | ion N | | nuary 1 | | | uaceu | | |
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| TEMPERAT | URES C | | PROCES | S-SOLVE | NT | RECOV | FHY | Y AND DE | YING | | | | Ti | ue. |
| From 17 | 24 | Col.vo- | | | -14 1 | NECOV | | I AND DI | | | | <u></u> | 71 | Hours |
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| 56 | 62 | Water | | | | · | | ······································ | | | | 2 | 6 | 44 |
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| PROPE | LLANT COMPO | SITION | | TS OF FIR | NISH | ED PRO | OPE | LLANT | STABILITY | AND | PHYSIC | AL TEST | 3 | |
| | Constituent | i | Percent Formula | - Sterence | | Datate 1082.6d | <u> </u> | | | | For | Mute | | Actual |
| | llulcse | | emainder | | | 95.6 | | Heat Test 1 | | | | 0'Min | | 60'+ |
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| Graphit | | | 0.50 | to 1.25 Max. | + | 0.90 | | Form at Prep | | _ | | | Cv: | <u> </u> |
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| | um Sulfa | | | 0 1.00 | | 0.9 | | Heat of | Explos | io | . N | /A | / 87 | 72.1 |
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| Moiture | and Vcl | atiles ! | 1.00 | ± 0.25 | <u>i_</u> | | | | | _ | | | | |
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| Bulk De | | ``` | | <u>'Max</u> to 1.050 | _ | 0.994 | | | | \dashv | | | | |
| | Foreign ! | Matter | 0.10 | · Max. | | 0.01 | | | | 一 | | | | |
| | CL | OSED BO | | | TP | ROPELL | AN | T DIMEN | SIGNS (in | che | 4) 22. | | | |
| | Lat Numbe | r Temp | | Fai .3 | \mathbb{L}_{-} | | · · | | | | | Mean 1 | Veriete en Din | on in % |
| Test | RAD-PE-5 | 59-3A+90 | 95.5 | 37.7 | ↓ _ | | - | Specification | Die | _ | mehed | 3944. | \Box | Actyp1 |
| } <u>'</u> | | | | | T | P(L) | | | 0.130 | | 0923 | | | 2.70 |
| Standard | P2078 | 1 +90 | 100,00% | 100.00% | | Pin (d) | | | 0.147 | | 0947 | 6.25 | | 2.59 |
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| · · · · · · · · · · · · · · · · · · · | | | | | 10.1 | | | 5 - 15 | 10.50 | 1 | 1.38 | | _ | |
| Type of Pocki | ng Cantainer | One Fi | ber Drum | @ 100 1b | s. | net. | | | | | | | | |
| Remerks | With tap | ping on | contriner | 1.008 | g/c1 | e loadi | กร | density | obtain | ed | | | | |
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| | a best e | ffort ba | R E of | 102_04_10 | ere | obtair | red. | - Prope | lant s | qæ | le pr | oduce | مه | n |
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| Cantrocter s | medresentative, | | | | 1 | . Samu) | 4 34 | willy Assurance | , patra a autatri | • | | | | |
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| U S Army Lo | No. RAD- | PE-559- | 5B | | ce | M9081 | ition No. | 25m | m MP | Prope | 11a | nt | for / | AP Pr | oje | crila |
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| 2015 | | SLEND NU | MBERS | | | | | _ | | | | | ···· | | | |
| B C-15 | ,038 | | | | | | | \dashv | • | en Conten | | Ki Şier | ch (65.5°C | Ste | bility (| (34 5°C) |
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| TEMPERA" | St. of 13 Math. | | | | S-SOLVE | | | | | | | | | T | | MĘ |
| From 17 | 7°. | \$01 | | | | | | | | 1/1/ | | | | 00 | 71 | Heurs |
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| 58 | 62 | | | After | Coating | | | | | | | | | +- | <u> </u> | 104 |
| ٥٠_ | <u> </u> | <u> </u> | LACU | D-LEL | COGLINK | | | | | | | | · | | | |
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| | | | | TEST | S OF FIN | IIS | HED PRO | PF | LLAN | T | | | - | | | |
| PROPE | LLANT COMPO | SITION | 1 5 | resni | Perce | | Prizent Medeure. | | | | ABILIT | OKA Y | PHYSIC | | 7 | |
| NI topo | cellulos | | | inder | Sierance | | 95.22 | <u> </u> | | , 134 | -500 | , | Form 36 40 | | | Actual |
| | ger in N | | | | + 0 05 | | 13.19 | | NO F | vnlos | ion | | 40 Hrs | MIN | 60 | |
| | uvlamine | | 0.50 | | 1.25 | | 0.86 | | No Explosion SHrs. MIN 5 Hr Form of Propella Type I Cylin | | | | | linder | | |
| Graph | | | 0.40 | | Max. | | 0.16 | | No. Perforations 7 | | | | | | 7 | |
| Methy | l Centra | lite | 3.2 | · | Nom. | | 3.03 | | NO. FELLOLACIONS | | | | | <u> </u> | | |
| | sium Sul | | | to 1. | | 一 | 0.89 | | Heat | of E | xplo | sio | : | | | ~ |
| Total | Volatil | es | 2.35 | 5 | Max. | | 2.23 | | cal/gm N/A | | | | | \ | 86 | 1.0 |
| | ure and | | | | + 0.25 | | 1.08 | | | | | | | | | |
| | ual Solv | | | .10 | Max. | | 1.15 | | | | | | | | | |
| | scopicit | 7 | | .80 | Max. | | 1.25 | | <u> </u> | | | | | | <u> </u> | |
| | Density | | | 0 to | | \dashv | 0.999 | 4* | | | | | | | - | |
| Dust | & Foreig | | | 10 | Max. | | 0.01 | | <u></u> | | | أحجا | - | | | |
| | | OSED B | | - ec: | : Keratien | | PROPELL | .AN | T DIR | IENSIC | NS (| inch | (85) | Hees | Verial | on in % |
| | DAD-DE-5 | | | -0101190 u-21-011 | Force | | | | | | | | | | | ***** |
| Test | RAD-PE-5 | יד מנידני | 70 9 | 1.3 | 98.0 | - | | 5 | ppc:ficatio | <u>n</u> | 130 | 0.0 | 923 | 6.2 | , | 2.70 |
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| Stangerd | P 2078 | <u>-9</u> | 0 10 | 0.00% | 100.00% | | | | | | .014 | | 0083 | 5.2 | | 2.59 |
| Remarks | | | - ' | | 1 | | b, Avs | Ċ | .0185 | Non | | | | 3 | DATE | 3 |
| | | | | | i | _ | b, Inn | | <u> </u> | | | | .016 | | 5/ | 12/77 |
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| | | | | | i | | | | | | | | | Test Finn | | |
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| | | ! | | | <u> </u> | 101 | THE AMERICA | 1 | | | .68 | - | 0.98 | | | |
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THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY
WEAPON LUT NUMBER PROPELLANT RAD-PE-559-5B ACCEPTANCE MODEL ACCEPTANCE DATE SHEET 25 May 1977 PROVING GROUND PROOF FIRED BY MFG BY HERCULES INCORPORATED FIRING RECORD NUMBER AT RADFORD ARMY AMMUNITION PLANT PROJECTILE WEIGHT PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-77-C-4007 TEMPERATURE OF POWDER ٥F STANDARD PROPELLANT LOT 110 pounds WEIGHT OF LOT PROPELLANT DESCRIPTION M TYPE **AVERAGE WEB** DATED WITH REVISION SPECIFICATION CHARGE WEIGHTS PROJECTILE WEIGHT TOTAL INCREMENT WT VELOCITY FT/SEC PRESSURE LBS/SQ IN. INCREMENT NO. INCREMENT WT. 25mm MP Propellant for AP Projectile Accepted for PE Project 559 THIS PROPELLANT LCT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION
THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE COMPLETE ROUND OR PROPELLING CHARGE WEAPON AND MODEL MODEL DRIWARG DATE OF LAST REV THIS LOADING AUTHORIZATION EXPIRES AFTER - WIL: 3E CONSIDERED. LAT WHICH TIME REBLENDING OR REASSESSMENT

SMU FORM 1050R MARCH 71

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY | WEAPON OT NUMBER PROPELLANT RAD-PE-559-5C ACCEPTANCE MODEL ACCEPTANCE DATE SHEET 25 May 1977 PROVING GROUND PROOF FIRED BY MFGBY HERCULES INCORPORATED FIRING RECORD NUMBER RADFORD ARMY AMMUNITION PLANT PROJECTILE WEIGHT PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-77-C-4007 TEMPERATURE OF POWDER CE STANDARD PROPELLANT LOT 110 pounds WEIGHT OF LOT PROPELLANT DESCRIPTION TYPE AVERAGE WES WITH REVISION DATED DATED SPECIFICATION CHARGE WEIGHTS PROJECTILE WEIGHT TOTAL INCREMENT WT VELOCITY FT/SEC PRESSURE LB3/SQ IN INCREMENT WT. INCREMENT NO. 25mm MP Propellant for AP Brojectile Accepted for PE Project 539. THIS PROPELLANT LOT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE COMPLETE ROUND OF PROPELLING CHARGE WEAPON AND MODEL TYPE MODEL DRIWARG DATE OF LAST REV THIS LOADING AUTHORIZATION EXPIRES AFTER WILL BE CONSIDERED. AT WHICH TIME REBLENDING OR REASSESSMENT

বৰ কৰিব বৈশ্বস্থানে কৰিব কৰিব কৰিব কৰিবলৈ ল'বৰ কৰিবলৈ সংখ্যাৰ লগতে কৰিবলৈ ল'বলৈ ল'বলৈ কৰিবলৈ কৰিবলৈ কৰিবলৈ কৰিব বিশ্বস্থাৰ

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| US Army Let No. | RAD | -PE-559- | -5C | | Ce | mpet: | tion No | 25 | mm MP Pr | opella | int f | or Al | Pro | iect | ile | |
| i | | | | | | | | | | | | <u> </u> | | | | |
| Many factured at R | RADFORD | ARMY A | MMU | VITION F | LANT, RAI | DFO: | RD. VA. | | Pected Amoun | , <u>11</u> | 7 10 | S. | 3-4- | | | |
| Contract No | DAAAU9 | -//-C-400/ | | | Dete4-1- | -1/_ | Specificate | m Ne | | | | | darec | <u>. </u> | | |
| ACCEPTED BLEND NUMBERS NITROCELLULOSE | | | | | | | | | | | | | | | | |
| | ACCEPTED | BLEND NUM | BEHS | ····· | | | | T | Miterage Co. | | | | | | | |
| B C-15,05 | 8 | | | | | | | ٦. | Mitrogen Con | % | K! 2191 | ch (65.5°C | Ì | житу (| 134 5°C) | |
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| | | | | | | | | | worde | 1.19 | Nor | <u>1e</u> | | 30 | Mine | |
| | | | | | | | | <u>_</u> | | | | | E 201081 | <u> </u> | Mins | |
| 0.92 Pound | | | | MA | NUFACTU | RE | OF PRO | PEL | LANT | is - | | Ether | • | | | |
| Percentage Remis | | er Pound 4C? | yry We | iight Ingredi | ents Cafeleting | at — | . | LNGS | Nicehel and | | ounds . | 1101101 | per 10 | 30 Peu | nds Seivent. | |
| TEMPERATURES | °C . | | F | ROCES | S-SOLVE | NT | RECOVE | RY | AND DR | YING | | | T | Tit | | |
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| 58 6 | 52 | Air Dri | ed | After | Coating | | | | | | | | | | 104 | |
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| | | | | TECT | TO OF FU | uci | UED BOC | 105 | I I ANT | | | | | | | |
| PROPELLAN | IT COMPOS | ITION | , | Percent | rs of Fil | 4121 | Parsant | | LLANI | STABILIT | Y AND | PHYSIC | L TEST | \$ | | |
| | nstituent | | | ermule | 3 grerance | | Veasure. | 1 | Heat Test134 | 500 | | Ferr | | | Actual | |
| Nitrocell Nitrogen | | | | mainde | | | 94.75 13.19 | | No Explo | | | C 40' | | |)'+ Hrs | |
| Diphenvla | | | | 0 to 1 | | | 0.88 | | Form of Prope | | | | | Cylinder | | |
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| | entrali | | 3.7 | | ·Nom. | | 3.51 | | <u> </u> | | | | | | | |
| Potassium Sulfate 0.10 to 1.00 0.86 | | | | | 0.86 | | Heat of | | sion | | | <u> </u> | | | | |
| | | | | | Max. | | 2.08 1.04 | | cal/s | m | | N/A | 1 | 847 | 1.2 | |
| Moisture Residual | | | 1. | | + 0.25 Max. | \dashv | 1.04 | | | | | | | | | |
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| Bulk Dens | | | | 0 to 1 | | | 0.979 | 8* | | | | | | | | |
| Dust & Fo | | | | | ·Max. | | 0.02 | | | | | | | | | |
| | CL | osed B | | | i Heighte | | PROPELL | AN. | T DIMENS | SIONS (| inch | 88) XX | Mood | Variati | 100 to % | |
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| stendard P | 2078 | +9 | 0 | 00.00% | 100.00% | _ | | | | 0.014 | | .0083 | | DATE | | |
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| Contractor Angre | 100121100 | | | | | | Garage | * ~ | yety Assurance | Provide the same | | | | | | |
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| | | . WEA | PON | | | LOT NUMBER | |
|-----------------|--------------------|--------------|------------|---------------------------------|---------|--------------------|------------------------|
| | PELLANT | | | | | RAD-PE | -559-5D |
| | | MOD | EL | | | ACCEPTANCE | DATE |
| 5 | HEET | | | | | 6 Ju | ly 1977 |
| MEGBY HERCU | LES INCORPORATEI | | PRO | OF FIRED BY | | | PROVING GROUND |
| | | | FIRI | NG RECORD NUM | BER | | |
| A KADFO | RD ARMY AMMUNIT | LON PLANT | - | JECTILE | | WEIGHT | |
| CONTRACT NUMBER | R DAAA09-77-C-4 | ¥007 | | JECTILE LOT NU PERATURE OF P | | OF | |
| | | | | NDARD PROPELL | | | |
| WEIGHT OF LOT | 106 pounds | | - | | | | |
| | | PROPELL | ANT | DESCRIPTION | | | |
| TYPS | М | | | | | | |
| AVERAGE WEB | | | | | | | |
| SPECIFICATION | DATE | | | WITH REVISION | | DATEC |) |
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| | | | | WEIGHTS | | | |
| INCREMENT NO. | INCREMENT WT. | TOTA | L T WT. | PROJECTIL! WEIGHT | E | VELOCITY FT/SEC | PRESSURE LBS/SQ IN. |
| | | | • خد مخص | | | | |
| 25mm MD Drone | llant for AP P | ofostile | | | - 1 | | |
| Z Juli Me Prope | Hant for AF F | Olectile | | | - 1 | | |
| Accepted for | PE Project 559 | | | | - 1 | | u |
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| THIS PROPELLANT | LOT IS ACCEPTED | | | | | | |
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| | | | | | | E. BLAND | |
| | | | | | | MALITY ASSURA | NCE DIVISION |
| | LANT LOT DESCRIBE | O ABOVE MA | Y BE U | | ANY OF | | |
| WEAPON AND MO | | | | LING CHARGE | J. A 17 | | |
| | TYPE | 1,00 | EL | PROJECT WT | OR. | AWING D | ATE OF LAST REV |
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| THIS LOADING AL | JTHORIZATION EXPIR | IES AFTER_ | | AT WHICH TIM | E REBL | ENDING OR REA | SSESSMENT |
| LOADING AUTHOR | IZATION ISSUED TO | | | | | | |
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| , ,. | | PRO: | PELLA | NY D | ESCRII | PTIC | N | shei | 7 | | | |
|-------------------------|----------------------------|-----------------|------------------|----------------------|---|---|-------------|------------------|-------------|------------------------------|------------------------|----------|
| U S AIRT L | et No. RAD- | PE-559- | 5D | c. | Imposition No | 25mm | M Pro | opellar | t | | | |
| Lianulactured | RADFOR | ARMY A | MMUNITION | PLANT, RA | DFORD, VA. | Pac | ted Ameun | . 106 | lbs | · | | |
| Comract No | | 9-77-C-400 | 17 | Date 4-1 | -77Specifica | lien No | | | | | | |
| | ACCEPTES | BLEND NU | MBERS | NITE | OCELLULOS | SE | | ******* | **** | , , , , , , , , , | | == |
| BC-1. | 5,058 | | | | | NI NI | trogen Cen | Head K | Storch (| (65 5°C) | Stabili | ty (|
| | | | | | | Mesim | vn | % | | Mins | | |
| | | | | | ~ · · · · · · · · · · · · · · · · · · · | Arere | 13 | .19 . | | Mins | | - |
| | | | | IANUFACTU | RE OF PRO | PELLA | NT | l. | | | Esplosion | = |
| 0.92 | Pounds Solvent | | "Pry Waight Ingr | edients Consisting | 35 | ounds Neah | ol and | 65 | m4s | Ethe | T per 100 | Pe |
| Percentage TE MPERA | CRES C | 25 | PROCE | SS-SO! VE | NT RECOV | FRY A | ND DB | YING | | | | 7 |
| From 17 | 24 | Solven | t Recove | | | | | | | | Doys | _ |
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| <u>56</u> | 62 62 | Water | | Cootino | | | | ···· | | | 26 | _ |
| 58 | 0.2 | WIL DI | y After | COGLINE | | | | | | | <u> </u> | - |
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| PROPE | LLANT COMPO | BITICN | | | NISHED PR | ****** | ANT | STABILITY | 2MD P | HYSICAL | TEST\$ | _ |
| Vitroce | 11ulose | · | Remaind | Parca-4 Colerance | 96.72 | 2 | . 1 | 34.5°C | c | Fermu | min. | _ |
| | | ocellul | | 5 +0.05 | 13.19 | | Explo | | | | min. | |
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| | e Centralit | | 1.50 | Max. | 1.39 | No_ | perfo | rations | <u> </u> | | | |
| • | um sulfat | | 0.10 to | | 0.91 | Hea | t of | | | | | - |
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| | e & Volat 1 Solvent | | 1.00 | .+0.25 .™ax. | 0.91 | | | | | | | - |
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| DUSE & | Foreign CL | | 0_10 QMB | Max. | PROPELI | LANT | IMENS | | ' |) | | = |
| | Lot Numbs | | | Heightee Force | 1 | γ | | | · - · · · · | * | Mean Vol of Mean | rts D |
| rest | RAD-PE-55 | 59 <u> 50</u> 9 | 0 105.0 | 98.9 | Length (L) | Specil. | | 0.130 | 0.09 | | | 4 |
| | | | | | Diameter (D) | | | 0.130 | 0.09 | | 6.25 | - |
| Stonderd | P2078 | | 100.00 | % 100.00% | 1 | | | 0.014 | 0.00 | 083 | 0. | A |
| Remerks | | | | - | Web Aug. | 0.018 | 5 | 0.0263 | 0.0 | 178 ~ | ocked (| 6, |
| | | | | | Inner | | | 0.0310 | 0.0 | 168 5 | emple4 (| 6 |
| | | | | | Outer | 15 | | 0.0215 -36.19 | | 06 | er Finishe | |
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| | | | | 1 | 104 | 5-15 | | 0.68 10.50 | 0.9 | 8 F | escription orwarded | 3) - |
| | | One F | iban Dr. | n @ 100 11 | | , , <u>, , , , , , , , , , , , , , , , , </u> | | 10.00 | | ≝ĽL. | <u> </u> | = |
| Type of Pecs Remerks | ing Canteiner *Uncoated | | | | ons. For | Uncoa | ted ba | se sto | ck, | a Hea | t of | E |
| | of 963.8 | cal/c. | a +90 R | O of 130. | 52 and a | + 90 1 | RF of | 102.04 | wer | e obt | ained | Ι. |
| | Propellar | it produ | iced on a | best eff | orts basi. | s. | | · | | | | |
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| Contractor s | Representante | | | | Corerna | of Quality | , | Tensorry to yo | • | | | _ |
| | R. À. W | illiams | | | J. | E. B. | 150 | • | | | | |
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| | | | WEAPO | N | | | LOT NUMBE | R | | | | |
|----------------------------------|--|----------|------------------|----------|----------------|----------|--------------------|------------|------------------------|--|--|--|
| | PELLANT | | | | | | RAD-F | E-5 | 59-5E | | | |
| | EPTANCE | | MODEL | | | | ACCEPTAN | CE D | ATE | | | |
| 5 | HEET | | | | | | | | | | | |
| 1 | • | | | • | | | 6 J | ulj | 1977 | | | |
| MFG BY HERCU | LES INCORPORATEI | D | L | | OF FIRED BY | | PROVING GROUND | | | | | |
| AT RADFO | RD ARMY AMMUNITI | ION PL | A 3177 - | - | NG RECORD NUM | BER | 1110 | | | | | |
| 45, 4 | | | | | JECTILE LOT NO | ABER | WEIG | 3H1 | | | | |
| CONTRACT NUMBER | R DAAA09-77-C-4 | 4007 | [| TEM | PERATURE OF P | OWDER | | 0F | | | | |
| WEIGHT OF LOT . | 107 pounds | | } | STA | NDARO PROPELL | ANT LO |)T | | | | | |
| | | PRO | PELLAN | VT. | DESCRIPTION | | | | | | | |
| TYPE | М | | | <u> </u> | | | <u> </u> | | | | | |
| AVERAGE WEB | | | | | · | | | | | | | |
| SPECIFICATION | DATE | D | | | WITH REVISION | | DA | TED | | | | |
| | · | | | | | | | | • | | | |
| | | | | GE | WEIGHTS | · | | | | | | |
| INCREMENT NO. | INCREMENT WT. | | TOTAL EMENT V | VТ | PROJECT IL | E | VELOCITY FT/SEC | | PRESSURE LBS/SQ IN. | | | |
| | llant for AP Pr | oject | ile | | | | | | | | | |
| Accepted for | PE Project 559. | | | | | | | | | | | |
| | · | | | | 3 | | | | | | | |
| THIS PROPELLANT | LOT IS ACCEPTED | | | | | | | | | | | |
| | | • | | | | JAMES | E. BLAND | | | | | |
| | | | | | | | UALITY ASSU | IR AN | CE DIVISION | | | |
| BELOWEXCE | LANT LOT DESCRIBE PT WHERE QUANTITE | D ABOV | SPECIFI | SE US | LY ALLOTTED F | ANY OF | | | | | | |
| WEAPON AND MO | DDEL COMPLETE | 805200 | MODEL | | LING CHARRE | 087 | AWING | G.a | TE OF LAST REV | | | |
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| U S Army Le | RAD- | PE-559-5 | 5E | | Cer | npesil | ion No | 25n | nm MP Pr | opc11 | ant | | | | |
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| Manufectured | RADFORD |) APKY A | MMUN | ITION P | LANI MAL | <u> </u> | VA. | | , Packed Amous | | | | | | i |
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| | ACCEPTED | BLEND NU | MOERS | | NITR | OCE | LLULOS | Ε | | | | | | | |
| BC-15 | | | | | | | | | Hitroran Cor | ntent | XI Sie | rch 165 5°C | Stat | iluty (| 1345°C) |
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| Contractor s | Representative | | | | | | Gererase | n.l | | | | | | | |
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LU FORM 10474 MARCH 1971

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CORRECTED COPY

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| | | | ' | | | | KAD-PE-S. | J7 - 0 | (ie) |
| ĺ | ACCEPTA | | MODEL | | | | ACCEPTANO | CE DA | TE |
| | SHEET | - | 1 | | • | | | | |
| i | | | 1 | | | | 27 July | 1977 | |
| | MFG BY HERCULES: INCO | RPORATED | | | OF FIRED BY | | | P | ROVING GROUND |
| | AT RADFORD ARMY | AMMINITION | PLANT | | NG RECORD NUM | BER | | | |
| | | | | | JECTILE JECTILE LOT N | IMBER | WEIC | SHT | |
| | CONTRACT NUMBER DAAAO |)9-77-C-4007 | | TEM | PERATURE OF P | GWDE R | | ٥F | |
| | WEIGHT OF LOT | 285 pounds | | STA | NDARD PROPELL | ANT L | OT | | |
| | | PR | OPELLA | NT | DESCRIPTION | | ······································ | | |
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| | 25mm Gun HE Projecti | le | | | | l | | | |
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| | THIS PROPELLANT LOT IS AC | CCEPTED | | | <u> </u> | i | | | |
| | Corrected copy issued | | | | | | | | |
| - 1 | weight of lot. | | | | | JAMM | S E. BLAND | | |
| | 4 | | 040/110 | A | | سيبيته خصه | QUALITY ASSU | RANC | E DIVISION |
| 1 | THE PROPELLANT LOT | DESCRIBED AB | OVE MAY | BE US | THORIZATION SED IN LOADING | ANY OF | THE AMMUNI | TION | ITEMS LISTED |
| | BELOW EXCEPT WHERE WEAPON AND MODEL C | QUANTITIES AF | | | | CR AP | ARTICULAR P | URPO | SE |
| | WEAT ON AND WIGHT | TYPE | MODEL | | PROJECT WT | DR. | AWING | DAT | E OF LAST REV |
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| | THIS LOADING AUTHORIZAT | ON EXPIRES A | FTER | | AT WHICH TIM | E RESL | ENDING OR R | E ASSE | SSME NT |
| Ď, | WILL BE CONSIDERED. | | | _ | | | | | |
| - | LOADING AUTHORIZATION IS | SUED TO | • | | | | | | ŀ |
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| S Army Let No. RAD-PE-559-6 (HE) S Army Let No. RAD-PE-559-6 (HE) Composition No. 25min Cutt HE Consideration | T | | |
|--|----------------|---------------|-------------|----------------------|
| S Army Let No. RAD-PE-559-6 (HE) Composition No. 25mm Cutt HE | | | | |
| PANAOD-77-C-4007 AMMUNITION PLANT, RADFORD, VA. Poched Amoun | - ikonik | TILE | ·—········· | |
| DAAA09-77-C-4007 Ann 4-1-77 COR 1 | 1.28 | 35 1bs. | | |
| AND THE PARTICIPATION OF THE P | letter | SARRA-E | N date | ed . |
| | bruary | 1977_ | | |
| ACCEPTED BLEND NUMBERS NITROCELLULOSE | | • | | |
| 0.15.000 | | | | |
| G-13 ,U38 | - 1 | Sterch (63 5* | - 1 | lhty (134 5°C) |
| | | | 100 | |
| Areres 13. | 12 . | 1.52 | w | 30+ _u |
| | | | E 4010 910 | |
| MANUFACTURE OF PROPELLANT 0.92 Pounds Solvent per Pound NC/Dry Seight Ingredients Consisting of 35 Founds Nicohol and | 65 000 | nd eth | er per ic | O Pounds Salva |
| PROCESS-SOLVENT RECOVERY AND DR | VINC | | | TIME |
| from 10 | 11140 | | 001 | 19 Howe |
| 17 24 Solvent Recovery | | | | 64 |
| 32 38 Solvent Recovery | | | | 24_ |
| 56 62 Water Dry | | ···· | 26 | |
| 53 62 Air Dried After Coating | | | | 7-3/4 |
| | | - | | |
| TESTS OF SIMPLED PROPERLANT | | | | |
| FROPELLANT COMPOSITION TESTS OF FINISHED PROPELLANT * | STABILITY | AND PHYSIC | . TESTS | |
| Constituent Formula Constituent Percent Percent Constituent Consti | | | 1 | <u>Actual</u> |
| troccllulose Remainder, 92.58 Heat Test 1 | | _tcc | ·-· } | 60' |
| trogen in Nitrocell. 13.15 + 0.05 13.12 No Explose phenylamine 0.50 to 1.25 0.68 form of Property | | | 7 | 5 Ilrs+ |
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| thy! Centralite 4.56 ! Nom. 4.59 | <u>oracruí</u> | 15_1 | - | |
| tassium Sulfate 0.10 to 1.00 0.81 Heat of | | | | · |
| | ion,cal | 1/500 0 | N/A | 828 |
| isture & Volatiles 1.00 + 0.25 1.23 | | | | |
| sidual Solvents 1.10 Max. 0.19 | | | | |
| groscopicity 1.80 Max. 1.43 | | | | · |
| lk Density 0.940 to 1.050 0.9974 | | | | |
| st & Foreign Matter 0.10 Max. 0.03 | | | | |
| CLOSED SOMB PROPELLANT DIMENS Lot Manuer Temp of Queeness Force | IONS (in | chos)** | Hern V | oricion in % |
| 747 77 550 ((vv)) 100 1107 06 100 06 | | <u> </u> | 01 1147 | n Dimensions |
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| | | 0.0529 | 6.25 | |
| eathAD-PE-559-A3 +90 100 00% 100 00% 201 00 101 0 .006, Nom | | 0.0091 | 7 | C3140 |
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| | | | Pecked | 7/16/77 |
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| · · · · · · · · · · · · · · · · · · · | | 5.83 | Farwarded | 7/23/7 |
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| et Pecting Contenner Fiber Drums: one (1) 3 100 lbs. net; one (1) 6 | 135 1 | bs. net | ; seve | in (7) |
| 0 150 lbs. net. | | | | |
| | | - | | |
| Made and reported per Dig. No. 11731646 from Frankford Arsen Uncoared propellant dimensions. | | | | |

Guerranent Questy Accordes Representative

Contractor & Representative

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY WEAPON LOT NUMBER PROPELLANT RAD-PE-559-7 (AP) ACCEPTANCE MODEL ACCEPTANCE DATE SHEET 22 August 1977 PROOF FIRED BY PROVING GROUND MFG BY HERCULES INCORPORATED FIRING RECORD NUMBER AT RADFORD ARMY AMMUNITION PLANT PROJECTILE **WEIGHT** PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-77-C-4007 TEMPERATURE OF POWDER
STANDARD PROPELLANT LOT 474 lbs WEIGHT OF LOT PROPELLANT DESCRIPTION M TYPE AVERACE WEB DATED WITH REVISION DATED SPECIFICATION CHARGE WEIGHTS TOTAL INCREMENT WT PROJECTILE WEIGHT PRESSURE VELOCITY FT/SEC INCREMENT WT. INCREMENT NO. 25mm 7 PERF Fromellant for AH Projectile Accepted for PE Project 559. THIS PROPELLANT LOT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION
THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE COMPLETE ROUND OR PROPELLING CHARGE WEAPON AND MODEL DATE UF LAST REV TYPE MODEL PRCJECT WT **DRAWING** THIS LOADING AUTHORIZATION EXPIRES AFTER WILL BE CONSIDERED. AT WHICH TIME REBLENDING OR REASSESSMENT LOADING AUTHORIZATION ISSUED TO

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CHIEF QUALITY ASSURANCE DIVISION

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| U S Army Lo | No. RAD-PE | -559 - 7 (A | P) | Con | npesition 1 | ,25mm 7 | PERF Pro | pellan | for A | P Proj | ectile | 7 |
| | RADFORD | ARMY AMA | AUNITION P | LANT. RAC | FORD. | VΔ. | Parted Amou | . 474 | lbs. | | | ┑. |
| Contract Na | DAAA09- | 77-C-4007 | NOINT TON | Care 4-1- | 77 | pacification t | COR Le | tter SA | RRA-EN | dated | | ジに |
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| | ACCEPTED 1 | BLEND HUMBE | RS | NITRO | OCELL | ULOSE | | | | | | |
| C-15, | 058 | | | | | | Nitregen Ce | nieni Ki | Sterch (65. | 5°C) Stal | iluty (134 5°C) | 7 |
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| PROPE | LLANT COMPOSIT | rion | | S OF FIN | IISHED | PROP | ELLANT | STABILITY | AND PHYS | ICAL TEST | s | |
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| | Lat Number | Temp "F | Heigtive Guiceness | Force | FAC | /rusha | AI DIMEIA | aiena (ii | 1C1162) | Mega | Variation in % | 7 |
| Tant RAD | -PE-559-1(| | 102.70 | 98.12 | | | Specification | Die | Finahed | 3000 | | 7 |
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| Remarks | <u> </u> | - | | | Web Avg. | | 0.0185 | 0.026 | 3 0.01 | 78 Packed | 7/29/77 | |
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| | . A. Will: | iams | | | _ { | J | E. Blan | <i>ل</i> | | | | |
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| ACCEPTA | |
| SHEET | • |

| WEAPON . | LOT NUMBER |
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| | RAD-PE-559-8(AP) |
| MODEL | ACCEPTANCE DATE |
| | 22 August 1977 |

| r | | | | | APON | NMENT PURPOSES | LOT NUM | BER | |
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| | | | CORPORATE | • | FIR | OOF FIRED BY | MBER | PR | OVING GROUND |
| I | AT RADFO | RD ARM | TINUMMA Y | CION PLANT | | OJE CT IL E | | IGHT | |
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| | WEIGHT OF LOT . | | 3 1bs | | | NDARD PROPELL | | | |
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| Contractor | R | | | | | Geramen | ret Guet | My Armene | a Representat | ive | | |

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY WEAPON LOT NUMBER PROPELLANT RAD-PE-559-11(AP) ACCEPTANCE ACCEPTANCE DATE MODEL SHEET 10 January 1978 PROOF FIRED BY PROVING GROUND MFGBY HERCULES INCORPORATED FIRING RECORD NUMBER AT RADFORD ARMY AMMUNITION PLANT PROJECTILE WE IGHT PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-77-C-4007 TEMPERATURE OF POWDER STANDARD PROPELLANT LOT 971 lbs WEIGHT OF LOT PROPELLANT DESCRIPTION M TYPE AVERAGE WEB WITH REVISION DATED DATED SPECIFICATION CHARGE WEIGHTS TOTAL INCREMENT WT. PROJECTILE WEIGHT VEL CCITY PRESSURE LBS/SQIN. INCREMENT NO. INCREMENT WT. Propellant, Single-Base, Multiple Perf, Methyl Centralite Chated for 25mm AP-T Accepted for PE Project 559. THIS PROPELLANT LOT IS ACCEPTED JAMES E. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION
THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED
BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE COMPLETE ACUNO OR PROPELLING CHARGE WEAPON AND MODEL TYPE MOCEL. CRAWING DATE OF LAST REV PRO SECT WT _____AT WHICH TIME REBLENDING OR REASSESSMENT LOADING AUTHORIZATION ISSUED TO

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| us. Army ter No. ROD-PD- 12-11 (AC) Norbyl Concraling Coa | tod for | 75mm 4D-7 | ropellant, | Single | Bace | Multiple | Peri, |
| Manufactured et (ACTORD APMY AMMUNITION PI | | | | 971 1 | | <u></u> | |
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| Nitrocellulose Remainder | | 96 71 | | 2 134 5 | | | 60' |
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| Diphenylamine 0.50 to | 1.25 | j 0.89 | Form of Pro: | ellant | | lcv | lindar |
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| Methyl Centralite 2.25 | _Non | 1.92 | | ~ | | | |
| Potassium Sulfate 0.50 Total Volatiles 2.35 | Nom | 0.48 | | | | | |
| Moisture & Volatiles 1.00 | Max _±0_25 | 2 51 | Hest of | • | - | 100 | |
| Residual Solvents 1130 | Mary | 1 30 | sion, | :aL/gm | N/A | | 7_4 |
| Hygroscopicity 1.80 | Маж | 1.38 | Propell: | int | | | |
| Dust & Foreign Matter 0.10 | Max | 0.02 | | ity one | N/A | 110 | 2 |
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| R. A. Williams | | | J. J. Blan | C | - | | |

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| R | A. Will | Liams | | | | . c. | . Blana | | - | | | |

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY WEAPON LOT NUMBER PROPELLANT RAD-PE-559-13(AP) ACCEPTANCE MODE! ACCEPTANCE DATE SHEET 10 January 1978 PROOF FIRED BY PROVING GROUND MFG BY HERCULES INCORPORATED FIRING RECORD NUMBER RADFORD ARMY AMMUNITION PLANT PROJECTILS WEIGHT PROJECTILE LOT NUMBER CONTRACT NUMBER DAAA09-77-C-4007 TEMPERATURE OF POWDER STANDARD PROPELLANT LOT ٥E 988 lbs WEIGHT OF LOT PROPELLANT DESCRIPTION М TYPE AVERAGE WEB WITH REVISION DATED SPECIFICATION DATED CHARGE WEIGHTS TOTAL INCREMENT WT. PRESSURE L 35/50 IN. PROJECTILE VELOCITY FT/SEC INCREMENT NO. INCREMENT WT. WEIGHT Propellant, Single-Base, MF Methyl Centralite Coated for 25mm AP-T Accepted for #E Project 559. THIS PROPELLANT LOT IS ACCEPTED JAMES L. BLAND CHIEF QUALITY ASSURANCE DIVISION LOADING AUTHORIZATION
THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE COMPLETE FOUND OR PROPELLING CHARGE WEAPON AND MODEL TYPS MODEL PROJECT WT DRAWING CATE OF LAST REV THIS LOADING AUTHORIZATION EXPIRES AFTER - WILL BE CONSIDERED. AT WHICH TIME REBLENDING OR REASSESSMENT LOADING AUTHORIZATION ISSUED TO CHIEF GUALITY ASSURANCE DIVISION

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| BE USED | PRINATION CONTAINED HEREIN SHALL FOR GOVERNMENT PURPOSES ONLY DISCIPLINE | |
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| RAD-PE-559-13 (AP) | Computation No. Propellant. | Single-Ba |

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| U.S. Army Lat No. RAD | -PE-5 | 59-13 | (AP) | co | mousillen No. P | | | | MP Me | thyl |
| | Cent | tralit | e Coate | d for 25m | nm AP-T | | | • | | |
| Manufactured of RADEC | 9-77-C- | | MUNITION | PLANT, RAI | CFORD, VA. | Pocked Amo | | 88 1bs | -4 10 | Nov. 77 |
| Contract No | ,,-,,-c- | | | 23/4 | Specificati | No COLL TE | z, omac | TE G | .u 10 | 210 4 7 7 |
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| Diphenylamine | | | 0.50 to | | 0,86 | | settant TVD6 | | | Cylin |
| Graphite Methyl Centra | 1 4 4 0 | | 0.40 2.25 | Max | 0.16 | No. Per | foration | 15. | | 1 -7 |
| Potassium Sul | | | 0.50 | Nom Nom | 0.55 | | | | | |
| Total Voiatil | | | 2.35 | Max | 2,18 | Heat of | Explo- | | | |
| Moisture & Vo | | | 1 00 | '±0.25 | 0.96 | | -cal/gm | _ N/A | | 900 |
| Residual Solve Hygroscopicit | | | 1.10 1.80 | · Max · Max | 1.08 | Propel1 | | | | |
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| Bulk Density, | | | 0.940 to | 1.050 | 1 1,00 | | | | | |
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| rese RAD-PE-559 | | "ema ** | 102.46 | Force | | | T | T | et He | On Dimense |
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| Contractor's Representati | • | | | 7-2-7-2-7-2-7-2-7-2-7-2-7-2-7-2-7-2-7-2 | Government | f Quelly Assurpact | Angiasantes. | 4 | | |
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| | | | | WEAPON | V TRISMENT FURPOSE | J. C. T. | LOT NUMBER | | | | | | |
| | | PELLAI EPTAN(| | | | | RAD-PE-559 | | | | | | |
| | 2 | HEET | | MODEL | | | ACCEPTANCE | DATE | | | | | |
| | | | | l | | | 10 January | 1978 | | | | | |
| | MFG BY HERCUL | ES INCORPORA | ATED | i i | PROOF FIRED SY | | نده نیام پروندگاری بر کانتیان کانتیان معلون بزردگارای کارسی کانتیان بازی | PROVING GROU | | | | | |
| | AT RADFOR | D ARMY AMMUT | NITION PL | 1 7777 | FIRING RECORD NU | MBER | WEIGHT | T | | | | | |
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THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

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| U.S. Army Let No. RAD-PE-559- | | с | ameesition No. | Propellant, | Single | Base M | P Wethy | 1 | | | | | | |
| | | | | for 25mm Af | | - | | | | | | | | |
| Manufactured of RACFORD ARMY A | MINUNITION F | LANT, RA | OFORD VA. | rected Ame | wattau | | 1hs | 77 | | | | | | |
| Confrect No. SERVICE CONTROL OF THE | | _ Date | Specificat | ien Ne. COR 1 | ET, SAK | SA-IE di | <u> </u> | <u>ov //</u> | | | | | | |
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| 0.02 | MA | NUFACTU | RE OF PRO | PELLANT | | | | | | | | | | |
| 0.92 Peunds Suivent per Peund NC. Percentage Remis to Whole 16 | /Ory Weight Ingredi | ente Consisting | , <u>,, 35 </u> | ounds licensi and — | _65 Pow | . Ether | per 100 f | Pounds Solvent. | | | | | | |
| TEMPERATURES OF | PROCES | S-SOLVE | NT RECOV | ERY AND D | RYING | | | TIVE | | | | | | |
| TEMPERATURES C PROCESS-SOLVENT RECOVERY AND DRYING TIME Cays Pours 35 55 Increase Temperature from Loading to Cycle Level 12 | | | | | | | | | | | | | | |
| 49 61 Solvent Recovery 134 | | | | | | | | | | | | | | |
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| 56 62 cost 0 | oating Wat | er Dry | | | | | | 24 | | | | | | |
| | | | | جسيد ساد | | | | | | | | | | |
| PROPELLANT COMPOSITION | | 'S OF FI | NISHED PRO | DPELLANT | STABILITY | NO PHYSICA | L TESTS | | | | | | | |
| Constituen* | Percent Formula | Distance Descare | Perzent Mecsura | , | | Form | ula | Levuqi | | | | | | |
| Nitrocellulose | Remainder | | 96,46 | Heat Test S | P 134 | 50C %0 | cc sh: | 60' | | | | | | |
| Nitrogen in NC | 13.15 | ±0.05 | 13.16 | | lesien_ | | | | | | | | | |
| Diphenylamine Grapnice | 0.50 to | 1.25 | 0.87 | | CHICALL ADO | | <u> C</u> | linder | | | | | | |
| Methyl Centralite | | Max Non | 2.26 | No Per | foration | s | | // | | | | | | |
| Potassium Sulfate | 0.50 | Nom Nom | 0.47 | | · | | | | | | | | | |
| Total Volatiles | 2.35 | ! Max | 1 77 | Vant s | F Emplo- | | | | | | | | | |
| Moisture & Volatiles | 1.00 | + -0.25 | 0.75 | | | N/A | 180 | 4 2 | | | | | | |
| | 1.10 | Max | 0.92 | | | | ĺ | | | | | | | |
| | 11.80 | 1 Max | 1.30 | Propel: | | | | | | | | | | |
| Dust & Foreign Matter Bulk Density, gm/cc | 0.10 | Max | 0.04 | Loadah | ility, g | ad 1√\ | | 12 | | | | | | |
| | 0.940 to OM8** | 1.050 | 1 0 08 | ANT DIMEN | CIONO (i- | <u> </u> | | | | | | | | |
| Lat Number Temp | Teiction | Heigliee Forca | PROPELL | ANT DIMEN | SIONS (INC | :nes) | Mean Veri | tion in % | | | | | | |
| | 90 103 52 | 101.21 | | Specification | 314 | Franci | of Maon C | Actual + | | | | | | |
| | | 1 | Length (L) | | 0.130 | 0.1239 | | 2.45 | | | | | | |
| 1 | | | Diemeter (0) | | 0.147 | n naed | 5 25 | 1 85 | | | | | | |
| st-scara RAD-PE-559-7 (AR) + | 90 100.00% | 100.00% | | | 0.014 | 0.007 | OAT | £3 | | | | | | |
| Romerks | | <u> </u> | Ve}.× | | | | ected | | | | | | | |
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| 2001 ac (nom) Closed | l Bomb | <u> </u> | L.S | 1.3 nom | | 7.6 | erwerded / | 6/72 | | | | | | |
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| Type of Persing Controller | Fiber Dru | | 150 lbs. 1 | | lbs. ne | <u>. t </u> | | | | | | | | |
| Memeras *Dimensions a | | | | | | | | | | | | | | |
| Chemical res | results | correct | ed for TV | graphite, | _dust_ar | d forei | gn mat | ter | | | | | | |
| -1123 101 010 | This lot produced on a best effort basis. | | | | | | | | | | | | | |
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| Contractor's Representative | | | Constitution | T Quelty Assurance | *********** | | | | | | | | | |
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| R. A. Willi | .ams | | ! | L E. Blank | | | | [| | | | | | |

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

| | | NEAPO |)N | | | LOT NUMBE | R | |
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| | PROPELLANT | | | | | RAD-PE-55 | 9-15(| AP) |
| | ACCEPTANCE | MODEL | | | | ACCEPTANO | CE DAT | E |
| | SHEET | | | | | | | |
| | | | | • | | 17 April | 1978 | |
| | MFG BY HERCULES INCORPORATED | | | OF FIRED BY | | | PR | OVING GROUND |
| | AT RADFORD ARMY AMMUNITION P | LANT | | NG RECORD NUM JECTILE | 858 | WEIG | 2UT | |
| | CONTRACT NUMBER | | | JECTILE LOT NO | JM8 E R | | 3111 | |
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| | WEIGHT OF LOT 4,810 1bs | | 31 A | NOARD PROPECT | 71/1 L | .01 | | |
| | PROI | PELLA | NT I | DESCRIPTION | | | | |
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| | Propellant Single-Base, Pulti-H | erf Me | thy | L Centralita | Coat | ed f/25mm A | P_7 | |
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| | Accepted for PE Project 559. | | | | | | - 1 | |
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| | THIS PROPELLANT LOT IS ACCEPTED | · · · · · | | | | | i | |
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| | · | | | | | E. BLAND | ··· | |
| | 104 | DING | ALIT | THORIZATION | | QUALITY ASSU | RANCS | DIVISION |
| | THE PROPELLANT LOT DESCRIBED ABOV | E MAY | E US | ED IN LOADING | ANY O | F THE AMMUNI | TION IT | EMS LISTED |
| | BELOW EXCEPT WHERE QUANTITIES ARE WEAPON AND SODEL COMPLETE ROUND | | | LING CHA JE | <u> </u> | ANTICULAN | UNPUS | <u> </u> |
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| | ROPELLANT | | | SHEET | NLY | EXEMPT | CONTROL SYMBOL - PARA 7-2a R 335-15 |
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| Ö | | | FROM | | | | CEPTANCE DATE |
| | *: * * * * * * * * * * * * * * * * * * | DESCR | IPTION | OF PROPELLAN | T . | 7 - 2 (e - 1 v . | |
| MODEL | TYPE I (MP) | | E II (SP) | AVG WEB | LOT N | JMSER | |
| SPECIFICATION, REV | | | E 11 (3F) | | | E-559-16 (A | P) |
| | | | | | 6,999 | | |
| WFG BY | | AT. | | • | - [| ACT NUMBER | |
| HERCULES INCOR | | | | MMUNITION PLANT | | | |
| PROOF FIRED BY | | | | FIRING RECORD NUM | | jih i e e jiwe wi | Make State Background |
| والمراجعة المراجعة المراجعة | ··········· | المحمول المراجع والمساوات | | | | | |
| PROJECTILE | w e | IGHT | | PROJECTILE LOT NO | JMBER | | |
| TEMPERATURE OF P | 0W9 | • F | | STANDARD PROPEL | ANT LOT | * | |
| | | | CHARC | E-WEIGHTS:::: | | | |
| INCREMENT NO. | INCREMENT A | | كروب ويوان فالتعارضوات | WT PROJECTILE | | | PRESSURE LB/SQ |
| | | | ~,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | | | |
| THIS LOT OF PROPE | LANT IS ACCEPT | - | | | | , | |
| | | | E. BLAN | | | | uarv 1979 |
| LOADING AUTHORI ommunition items lis ourpose. | ZATION - The protect ted below except | opellant fot d where quantit | ties are s | above may be used in pecifically allotted fo | or a partic | any of the cular | DATE |
| WEAPON AND | MODEL | MODEL | TYPE | FROJECT NT | | LING CHAR | GE OF LAST RE |
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| This loading authori will be considered. | zation expires cit | er | at whic | h time reblending or | reassessi | ment | |
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| TYPED NAME AND TI | TLE OF APPROVI | NG OFFICIAL | sig | NATURE | | | OATE |

| | BE U | SED FOR GO | VERNMENT P | URPOSES ONLY | <u> </u> | | | | |
|--|---------------------|-----------------|--|----------------------------|---|------------------|------------|-----------|--|
| PROF | | | | HOIT | SHE | 7 | | | |
| US Army Lat No. RAD-PE-559 | -15(AP) | 64 | mposition Ns. Pr | opellant, | Single-F | Base, Mi | lri-P | ers | |
| \$] | | | Makhari | Cambre 1 4 b - | 01 | £ 10€ | 100 | | |
| Manufactured at RADFORD ARMY A DAAA09-77-C-400 | MMUNITION F | | <u> </u> | | Er SAF | RATE A | ared | | |
| Comrect 40 | <i>i</i> | _ Dare | -77Specificat | 16 1 | February | 1978 | | | |
| | | NITR | OCELLULOS | | | | | | |
| ACCEPTED BLEND NUM | IBERS | | | | | | | | |
| C-15134 | | | | Hilrogen C | i | Steren 165 5* | | hility (I | 34 5* 0} |
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| | | | | Average 1 | | | | 0+ | |
| | | | | | | | Espica | • | H ng |
| 0.92 | MA | NUFACTU | RE OF PRO | PELLANT | | | | | |
| 0.92 Pounds Solvent per Pound NEW | firy weight Ingradi | ents Consisting | ء ــــــــــ ه | gunda licandi an d | ٠٠٩ ـــــــــــــــــــــــــــــــــــ | mes <u>Eth</u> e | 7 per 10 | 00 Peur | de Sairert |
| Percentage Remix to Whole 16 | | | | ERY AND D | | | | TIV | |
| From 13 | | | | | | | 24 | ye. | Hours |
| | | | | nch Positiv | | | | | _32 |
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| 56 62 Water | Dry | acare, ii | alillalit. | 79-Inch Pos | STATIVE - | 12551176 | | 10 | 24 |
| 74 ! 76 Coatin | ng Cvcle | | | | | | | 111 | 2 |
| 56 i 62 Post (| Coating Wa | rer Dry | | | | | | | <u> </u> |
| PROPELLANT COMPOSITION | TEST | S OF FIN | NISHED PRO | OPELLANT | STABILITY | 440 24YSIC | 11 7557 | | |
| Constituent | Fermula | Derce-1 | Persent Wegsure | | | | rula | | ctuel |
| Nitrocellulose | 96.7 | ± 1.0 | 96.3 | 4 meat Test S | P. 134 | .5PC No | CC 6 | | <u>0'</u> |
| Diphenvlamine | 0.9 | ± 0.4 | 0.8 | | osion | 5 hr | nin | 5 | |
| Potassium Sulfate | | ± 0.3 | 0.5 | | | <u> Type</u> | | | inder |
| Mechal Centralite Total | | ± 0.5 | 2.2 | | foratio | ns 7 | | | 7 |
| 10064 | | · | 100-0 | | Explos | 7 - 37/ | | | |
| Graphite | 0,4 | Max | 0.2 | _ 1 | /on | 100 .47 | ä | ചവ | 5 |
| Total Volatiles | 2.9 | 1 Max | 2.0 | _ | nsity c | m/h. 0 | 940 + | | .011 |
| Residual Solvents | 1.7 | Max. | | 8 | | | 050 | | |
| Moisture | <u>l.l.</u> _ | 1 - 0.4 | 1.2 | | | | | | |
| Hygroscopicity Dust & Foreign Marter | 1.8 | Max Max | 1.3 | | lity g | msi N | <u> </u> | 103 | .6 |
| | 0MB" | 434 | O CORPORA | ANT DIMEN | SIONS (in | (2) | أحسد | | |
| Lat humber Teme | 300000 | Force | 11101 666 | -AITI DIME.I | 210112 III | Chasi | Mean V | Vortetion | in % |
| Test RAD-PE-559-15(AD) 4 | <u>95 101 9</u> | 5 100.24 | | Specification | Qie | Finance | 7046 | | Actual_ |
| | | | Langin (L.) | | 0.110 | 0.0996 | | | <u> 55</u> |
| Signeera RAD-PE-559-11 (12)+0 | 100 000 | 100000 | Dicmeter (D) | | 0.147 | 0.0041 | 8 20 | 12 | 72 |
| Remorts | 100.00% | 100.00% | Part Sie.(d) | | 10.014 | 0.0068 | | ESTAD | |
| | 1 | | - Nob Outer | | 0.0125 | 0.0194 | Persid | 3/3 | 0/78 |
| | | | Inner | | 0.031 | 0.0179 | Samered | |)/78 |
| *100 400 5000 | | ; | Averse | 0.0185 Non | | 0.0186 | Test Finie | heel | <u>3-7-</u> ε |
| *Loading Density of C 200 cc (Nom) Closed | | in | Wea Cillerence/ SIG Dev. In % of Web Average | 25.34 | -36 10 | 0 21 | Offered | | <u>17 с</u> 7/78 |
| 200 CC (Nom) Closed | מוויים | | L 0 | 1.1 Nom | | | Seecrotie | | |
| | | <u>!</u> | 0.4 | 5 to 15 | | 13,89 | Forwarde | 4/1 | 3/78 |
| Type of Pecking Contenner Fiber | Drums: | 32 9 150 | lhs Ver | | | | | | |
| | cal test | | | for TV. or | anhite. | dust ar | nd | | ······································ |
| | eign matt | | | | | ace di | | | |
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| | | | | | | | | | |
| | | | | • | | | | | |
| Contractor's Representative? | | | Severment | of Quidly Assertance | Poprendetelle | ^ | | | |

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

Carrar at a fair a sala a de a la calacata de catalacidade de la catal

| PROF | ellap | VT Da | ESCRIP | TION | SHEET | • | | | |
|--|--------------------|------------------------|---|---------------------------------------|----------------|----------------|--------------|--|-------|
| U.S. Army Lat No. RAD-PE-SS | 9-16(AP) | C+ | | ropellant, | | | | erf. |] |
| | | | | Centralit | 6 000 1 | | T-9A | والفائدانية والنود | ٠, |
| Manufactured of RADFORD ARMY A DAAAG9-77-C-4007 | MMUNITION F | | | COR 1 | etter SAR | | dated | 1 | 18 |
| Comtract No. DARAGETT-C-400) | | 0410 | 77 Specification | M 148 | 8 and 12/ | | | <u>. </u> | 1 |
| ACCOUNTS OF SHE MILL | | NITR | OCELLULOS | | | | | | Ī |
| C-15,223 | 10542 | | | | | ma (65.5°C) | 1 52-2111- | . (12.4.64.4.) | 7 |
| | | · | ~~~ | Mesimum | AL 3161 | Mine | Statut | y (134 5°C) Mins | |
| | | | | Minimum | % | Mins. | | Mins. | 1 |
| | | | | Arerege | 3.16. | M.ne. | 30 |) wins | |
| | | | | | <u>i</u> | | Espiesion . | Wins | 4 |
| 0.92 Pounts Servent per Pount NC/ | | | RE OF PRO | | 65 | ether | per (CO) | Paunde Salvent, | |
| TEMPERATURES OF | 220000 | | V.T. MEGOVI | TOV AND DE | | | _ | 7 46 | ╡ |
| Prom "3 | | | | RY AND DE | | | Saye | Maure | 7 |
| The same of the sa | | | | ch Positiv ch Positiv | | | | 32 | 4 |
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| 56 62 Water | | | <u> </u> | <u> </u> | 10100 110 | 33414 | 10 | | 1 |
| | g Cycle | | | | | | | 2 |] |
| 56 | oating Wa | | | | | | | 1 48 | |
| PROPELLANT COMPOSITION | | | HISHED PRO | PELLANT | STABILITY AND | | TESTS | | |
| Constituent | Percent Formula | Percents | Percant Messure | · · · · · · · · · · · · · · · · · · · | | Formu | | Jetual |] |
| Nitrocellulose | 96.7 | ±1.0 | 96.2 | | P.134.5°C | | | 60'÷ | 4 |
| Diphenylamine | 0.9 | ±0.4 ±0.3 | 0.8 | - | | 5 hz | | 5 h= | 4 |
| Potassium Sulfate Methyl Centralita | 1.9 | ±0.5 | 0.4 | | iorations | Type | 1 (30) | inder 7 | 1 |
| TOTAL | 100.00 | <u>, ÷V.J.</u> | 100.0 | | Explosion | | | | - × × |
| Graphice | 0.4 | Max | 0.1 | | 1/gm | N/ | | 89.9 | 4 |
| Total Volatiles | 2.9 | : Max | 1.9 | | | 0.94 | | |] |
| Residual Solvents | 1.7 | Max | 0.9 | | /cc· | 1.05 | 0 | 1.011 | 4 |
| Moisture Hygroscopicity | 1.1 | <u>. ±0.4</u> ! Max | 0.9 | 0 9 Loadibi | lity, 2m | N/A | | 101.0 | ╣ |
| Dust & Foreign Matter | 0.1 | Max | 0.0 | | 110 Y 1 7 111 | | | 101.0 | 1 |
| | | : | | | | | | | 1 |
| CLOSED B | омв | | PROPELL | ANT DIMEN | SIONS (inch | 93) _ | Mana Vai | atice in % | 1 |
| Las Number Teme | | Force | } | | | | | 21mon signs | 1 |
| ree RAD-PE-559-16 (AP) +9 | 0 100.75 | 100.61 | | Specification | 0.110 D. | Menod (1200 | 6.25 | 2.07 | 1 |
| i i | - | | Langth (L) Diameter (D) | | 0.147 C. | | 6.25 | 11.59 | 1 |
| StandardRAD-PE-559-15(AP)+9 | 0 100.00% | 100.00% | | | 0,014 D. | | | TES | † |
| Remoras | | | Web. Out | | 0.012510 | | | _ | |
| | | | Inne | | | .0181 | | <u>25/79</u> | 4 |
| * Loading | .2 gm/cc | | AVE | 0.0185 Nom | | .0187 | T beams | 25/79 | 4 |
| 200 bc (Nu | omb | <u> </u> | Wee Sifference/ Sie Sev in % of Wee Average | | | | ost Einisped | | ↓ . |
| | | 1 | | 15 Max | -36.19 5 | .02 | Ifered 2/ | 2/79 | 1 |
| | | | 5 3 | 1.1 Nom 5 to 15 | | | W-47694 | /6/79 | |
| FTRER | DRUMS: A | .6 a 150 | | | | | | 07.79 | 4 |
| Type of Posting Container | DRUMO. | 40 6 130 | los. net; | 1 @ 89 15 | s. nec. | | | | 1 |
| Chemical test result | 0.0077045 | - d - E TT | 7 | a 4.ab .a | d familia | | | | { |
| Chemical cast result | s_correcto | ed for th | y. grapnit | e. dust an | d totelan | marre. | <u> </u> | | 1 |
| This lor meets all s | pecificat | ion requi | rements. | | | | | | |
| | | | | | | | | | |
| Centragine s Representative | -, | | Gerenne | Questy Assurance | Aspros adellas | | | | |
| k. A. williams | | | James | E. Bland | | | | | |

| | PROPELI | MY BEUS | SED FOR GO | CONTAINED PERMENT PU | HEI | REIN SHALL DSES ONLY | | | REPOR EX F | 15 CORTO 1PT-P/ 335 | (01 . Y \RA -15 | мво г 7-2 3 |
|---|---------------------------------------|----------------------------|----------------------|-----------------------------------|------------------|-------------------------|-------------|-----------|---------------|---------------------------|-----------------------|------------------------------|
| | COMPOSITION M10 f/25nm | | | | | LOT NUMBER | RAD-PI | E-5: | 59-17 | (AP) | | |
| | SPECIFICATION COF lecter SARPA-TE | E. dated 4/ | 29/80 | | PAG | CKED AMOUNT | 5,032 | 1bs | s . | | | |
| | MFG AT RADFORD ARMY AME | | | ORD. VA. | col | NIPACI NUMBE | R DA | AAO | 9-77-1 | C-400 | 7 | |
| ١ | · · · · · · · · · · · · · · · · · · · | | | CELLULOS | Ē | | | • | | | | ********** |
| | A-CEPTED I | BLEND NUMBERS | | | | NITROGEN CO | NIENT | | ARCH | STABIL | IIY (13 | 4.5° C} |
| | C 15315 | | | | + | //AX | | (65. | .s•ci | | | MIN |
| | | | | | | MIN | 7. | | MIN | | | With |
| | | | | | | AVG 13.15 | % | 45 | +_min | 30 | | WIN |
| | | 1132915 | errine of | SOLVENT | | 69511 AUY | | | | EXPLOSI | ON | HR |
| | 0.92 POUNDS SOLVENT PER PO | | | | | | | IOHO: | AND | 65 | POL | INDS |
| | ether PER 100 POUNDS SOLVENT | PCRCEN' | TAGE REMIX TO | WHOLE 16 | | | | | ~~~ | | | |
| | FROM TO | | | ilt revove | | | | | | DAT | 1,60 | HOURS |
| | 21 Maint | ain Inert (| | | | | | | | | | 32 |
| | | ain Inert C ase Tempera | | | | | | | | | \dashv | 32 24 |
| | 21 35 Incres 56 62 Water | | icure, Ma | incain 1/ | 4 -) | inch rosi | rive o | res | oure | $-\frac{1}{1}$ | 0 | 24 |
| | | ng Cvcle | | | | | | | | | | 2 |
| | | Coating Wat | | | | ····· | | ~~ | | | | 48 |
| | PROPELLANT COMPOSITION | | | PROPELLA | | 77 A. V. V | STA | BILITY | AND PH | YSICAL 1 | | |
| | CONSTITUENT | PERCENT FORMULA | PERCENT TOLERANCE | | | HEAT TESS. | D 12/ | 504 | FOR C | | 60 ¹ | TUAL |
| | Nitrocellulose | Remainder 0.9 | +0.4 | 95.88 | | NO EXPLO | | | 5 hr | | 5 h | |
| | Diphenylamine Potassium Sulfate | 1.0 | ±0.3 | 1.14 | | FORM OF PR | | - | Туре | | | inder |
| | Methyl Centralite | 1.9 | Nominal | 2.15 | | No. Perf | | | 7 | | 7 | |
| 9 | TOTAL. | 100.0 | | 100.00 | | Heat of | Explos | ion | | | 900 | |
| | Graphice | 2.9 | Max Max | 0.14 1.68 | | cal/g Eulk Den | ci +ır | | N/A | 0 to | 892 | |
| | Total Volatiles Residual Solvents | 1.7 | Max | 0.44 | | g/cc | SILY | -1 | 1.05 | | 0.9 | 92 |
| | Moisture | 1.1 | ±0.4 | 1.24 | | | | | | | | |
| | Hygroscopicity | 1.80 | Max | 1.33 | | | | | | | | |
| | Dust & Foreign Matter | 0.10 | Max | 0.03 |) | | | | | | - | |
| | SWARE CENERA RE | | | 333 | 164 | Transfer Diff | El:Slu | <u>'S</u> | line | 18.8 | | |
| | | F CHICKNESS | RELATIVE FORCE | | | | | | | | . DFV. on Dim | in % ensions |
| | 1681 RAD-1/E-559-17 (AP) +9 | 0 100.33 | 99.09 | LENGTH (L) | | PECIFICATION 1062 nom | 0110 | | NISHED 104 | 5PEC 6.25 | | ACRIAL |
| | | | | | | 0949 nom | | | 0935 | 6.25 | - | 1.98 |
| | 7/2-7/2 | | | PERF. DIA. (d) | | | 0.014 | 0. | 0064 | - | DATES | |
| | STANDARD 339-16(AP +9 | 0 100.00% | 190 00% | Web, Out | - | | 0.0125 | | | PACKED | 7 1 | 'no tao |
| | REMARKS | | | Inno | | 019±0.002 | | | | SAMPLE | 0 7/ | <u>29/80</u> 29/80 |
| | Loading density of 0.2 | • | | | | | | | | | | /20/80 |
| | 200 cc (nom) closed bo | mb | | Web Difference /Std. Dev. in % | 20 | max | -36.19 | 8. | 78 | OFFERED | 8, | 27780 |
| | | | | al Web Avg. L:D | | 9 to 1.3 | | 1. | | DESCRIP | TION S | HEETS |
| | | | | D-q | 5 | to 15 | | 14 | .59 | | 9 | -23-S(|
| | TYPE OF PACKING CONTAINER FIBE | R DRUMS 652 | 2D: 33 @ | 150 lbs. | ric | et; 1 0 5 | 5 1bs. | ne | t. | | | |
| j | REMARKS Chemical test results | aanmaakad | for TV | rranhita | ሐ | er and f | orain | יות ר | tter | | | |
| | Chemical test results | corrected | TOT 14, 8 | graphitie, | uu | ar, and I | orergi | | | • | | |
| | This lot meets all spe | cification | requirer | ments. | | | | | | | | |
| | | | | | | ···· | | | | | | |
| | SIGNATURE OF CONTRACTOR'S KUIRESE | NEATIVE | | SIGNATURE | OF G | OVERNMENT O | UALITY AS | ANUC | HCE AFF | KESETTA T | :vE | |
| | | | | | 12 | Dland | | | | | | |
| Į | R. A. Williams | | | Lames | r. | Bland | | _ | ~ | | | |

ARROOM FORM 2148 10 AUG 77

| PROPELLAUT | 82 (| ISED FON GOVER | ONTAINED HEREIN SHA NMENT PURPOSES ONL HEET | REPORTS C | ONTROL SYMBOL - PARA 7-20 335-15 |
|---|------------------------------|--|---|--------------------------------|---|
| | | FROM | | | September 1980 |
| | : - DES | CRIPTION OF | F PROPELLANT. | e de als managinasiones | and the first of the second of the second |
| ACDEL TYPE I (MP) | | YPE II (SP) | AVG WEB | OT NUMBER RAD-PE-559-17 (A) | · · · · · · · · · · · · · · · · · · · |
| PECIFICATION, REV, DATE one AME | | | 1 | OT QUANTITY 5,032 lbs | |
| AFG BY | IAT | | | ONTRACT NUMBER | |
| HERCULES INCCRPOSATED | ! | ORD ARMY AMM | • | DAAA09-77-C-4007 | |
| | | AND RESIDENCE OF PROPERTY AND ADDRESS OF THE PARTY. | | | Ywar am in a gaile a 🐇 |
| PROOF FIRED BY | PROV | ING GROUND FIF | ING RECORD NUMBE | R . | • |
| ROJECTILE W | EIGHT | PR | OJECTILE LOT NUMB | ER | |
| TEMPERATURE OF POWDER | • F | \$7. | ANDARD PROPELLAN | T LOT | |
| | e material | A CHARGE | WEIGHTS | nayasan kuniski | ele verywith to ja |
| INCREMENT NO. INCREMENT | WT TOTA | l increment wi | PROJECTILE WT | VELOCITY FT/SEC | PRESSURE LB/SQ II |
| ACCEPTED FOR PI PROJECT 55 | 9 | | | | |
| M10 f/25mm | | • • | | : | |
| | | • • | | | |
| | | | | | |
| | . | · | • | | • |
| | | | | | |
| THIS LOT OF PROPELLANT IS ACCEP | TED. | برغيه ره الحد -بدمسوست | | | |
| | JA! | Mes c. Blai. | | 22 Septem | ber 1930 |
| OADING AUTHORIZATION - The gammunition items listed below excep | propellant le t where que | ot described about the special | ve may be used in lo | ading ony of the | |
| WEAPON AND MODEL | | | | OPELLING CHAR | |
| | MODEL | TYPE | PROJECT YT | DRAWING | DATE OF LAST RE |
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| This loading authorization expires o will be considered. | ifter | at which | time reblending or rec | assessment | <u></u> |
| LOADING AUTHORIZATION ISSUE | D T0 | · · · · · · · · · · · · · · · · · · · | | • | |
| TYPED NAME AND TITLE OF APPRO | VING OFFIC | IAL SIGNA | TURE | | DATE |
| • | | | | | |
| ARRCOM Form 210-R. 10 Aug 7 | | 162 | | | |

| · PROPELLA | INT ACCEP | ED FOR GOVERN | ntained Herein Sha nment purposes one HELT | Y REPORTS EXEMPT | CONTROL SYMBOL F — PARA 7—2a R 335—15 |
|--|-------------------|------------------|--|--|--|
| 70 | | FROM | | | CEPTANCE DATE 2 September 198 |
| Park of the Committee of | DESC | RIPTION O | | | ar akka tatak 1 MA |
| MODEL TYPE ! !! | AP; [7] TY | PE II (SP) | AVG WEB | RAD-PE-559-18(| AP) |
| SPECIFICATION, REV, DATE and | AMENDMENTS | | <u> </u> | LOT QUANTITY 48 lbs | |
| MEG BY | | | | CONTRACT NUPBER | |
| HERCULES_INCORPORATED | RADFO | DAY YERA DR | UNITION PLANT | DAAA09-77-C-4007 | , |
| PROOF FIRED BY | PROVI | IG GROUND FIR | NING RECORD HUMBI | • | |
| PROJECTILE | WEIGHT | 1281 | OJECTILE LOT NUM | BER | |
| TEMPERATURE OF POWDER | 9.5 | STA | ANDARD PROPELLA | NT LOT | · |
| averagas, see see see s | | | | | |
| INCREMENT NO. INCREM | TOTAL | INCREMENT YT | PROJECTILE WT | VELOCITY FT/SEC | PRESSURE LB. SO I |
| M10 f/25 mm | CEPTED | | | | |
| | | E. BLAND | | 22 Septem | |
| LOADING AUTHORIZATION - T ammunition items listed below e purpose. | he propellant los | ntities are spec | ve may be used in li ifically allotted for | | CGE AND CASE |
| WEAPON AND MODEL | MODEL | TYPE | PROJECT WT | DRAWING | DATE OF LAST RE |
| - | | | | | |
| This loading authorization expir will be considered. | es after | at which t | lime reblending or re | ri sessment | J |
| LOADING AUTHORIZATION IS | OT GBU | | | | • |
| T.PED NAME AND TITLE OF API | ROYING OFFICI | AL SIGNA | TURE | agentagen de America (n. 1874). L | DAT |
| ARRON Form 210-R 10. Au | ~ 77 | 163 | | DE THE COUNTY OF LOCAL PROPERTY AND ADMINISTRATION | E Landson X (Million All III d'All III T Y |

| | P | 10P | ELI | AR BEN | NFORMATIC | ON CONTAINED | URP | REIN SHALL | | | EX EI | PT-PAR 335 | IRA 7 | 1801 -2a |
|------------------|---------------------------------------|-------------|-------------|---------------------------------|---------------------|---|--|--------------------------------------|------------------|--------------|------------------|------------------|---------------|-------------|
| COMPOSITION | M10 | f/25 | mm | | | | 1 | LOT NUMBER | RAD-PE | :-5' | 59-18 | (AP) | | |
| SPECIFICATIO | 1 | | | : //20/00 | | | PA | CKED AMOUNT | 48 1bs | . <u></u> | | · | | |
| | | | | d 4/29/3C | 117 DAD | | <u>. </u> | HIRACI NUMBE | Ú | | | 100 | - | |
| RA | DEUKU AI | RIAY | AMI | UNITION PL | | | | | UAI | RAU | 9-77-(| J-4UU | ~~~~ | |
| | | | | - | ilitr | OCELLULOS | | | | | | | | |
| C-15,3 | 115 | ACCE | PTED B | LEND HUMBERS | | | - 1 | NITROGEN CO | NIENT | | ARCH | STABIL | 11 Y (134 | (2.C) |
| F 5-13,3 | | | ···· | | | | ㅓ. | MAX | - | • | MIN | | | MIN |
| | | | | ····· | | | _ | MIN | | | MIN | | | _ MIN |
| | | | | | | | | AVG 13.1 | 5 % | 4 | 5+MIN | | | MIN |
| | · · · · · · · · · · · · · · · · · · · | | | | | · | | | | - | | EXPLOSIO | N | HP |
| | • | | | · Itaruf | acture 9 | F SULTERT | Pk | OF ELLASIY | | | | | | |
| 0.92 | POUNDS SOL | VE!IT P | ER PO | UND NC/DRY WE | IGHT INGREDI | MIS CONSISTING | OF | 35 poi | UNDS ALCO | HOL | AND | <u> 55</u> | , १୯७ | NDS |
| ether | PEP 100 POUT | os sot | VENT | | TAGE REMIX I | | | 1.05 5000 | 160 | | | -7 | HAGE | <u> </u> |
| FPOM | ΙQ | | | | | ein aecori | _ | | - | | | | | HOURS |
| | 21 | | | in inert g | | | | | - | | | | | 32 |
| <u> </u> | 21 | | | ir inerr s | | | | | | | ~~~~ | | | 32 |
| 21 | 35 | | | se tempera | ture, ma | intain 1/4 | ىتت | nch posit | ivs br | ess | mie - | | 0 | _24. |
| <u>56</u> 74 | 62 76 | | e- 1 | Cvcle | | , , , , , , , , , , , , , , , , , , , | - | | | | | | <u> </u> | - |
| 56 | 62 | | | pating Wat | ar Dry | | | | | | | | | 48 |
| | NT COMPC all | | <u> </u> | | | 3-PROPELLA | diT | | STAI | EILITY | AND PH | YSICAL T | ests Ests | |
| | ONSTITUENT | | _ <u>`</u> | FERCENT | PLICENT TOJERANO | | | | | | FORI | | | TUAL |
| <u> </u> | llulose | | | Remainde | | 94.71 | : | HEAT TEST S | P 134. | 500 | | | 601 | |
| Dipheny | | | | 0.0 | ±0.4 | 0.93 | | NO EXPLO | | _ | | niel | 5 h | r |
| | นก Sulfa | ite | | 1.0 | ±0.3 | 0.95 | | FORM OF PE | OPELLANT | | Type | I | Cyl | inder |
| | Centrali | | | 1.9 | Nomina | | | No. Perf | oratio | ns | 7 | | 7 | |
| TOTAL. | | | | 100.0 | | 100.00 | | Heat of | | <u> 10</u> 0 | | | | |
| Graphit | | | | 0.4 | Max | 0.9 | | cal/ | | | N/A | | 902 | .0 |
| | <u>'clariles</u> | | | 2.9 | Max | 1.38 | | Bulk Den | | | | 0 to | 0.9 | 07 |
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| C 3 C 3 | | ACCEP | IED EL | END NUMBERS | | | T | NITROGEN CO | INTENT | | TARCH | STABI | ITY (13 | 4.5 'C) |
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| PROPELL | ANT COMPOSIT | 1011 | | | | O PROPELL | | A . (1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 | STA | BILITY | AND PI | YSICAL 1 | ESTS | |
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| | פאניא זחן | | EMP ? | S QUICKNESS | RELATIVE FORCE | | | | | | | of Me | . CEV. on Dim | ensions |
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| -RAD-PI | | | | | | PERF. DIA. (d) | | ·~ ~~~ | 0.018 | | | | DATES | |
| DRACHATE | 559-16(| AP) | 490 | 100.00% | 100.00% | Web, Oute | r | | 0.0285 | | | | | |
| REMARKS | | | | | | Inno | | | 0.0 395 | | | | | |
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| к. Л. | Williams | 5 | | | | James | r. | Bland | | | | | | |

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| | 1.5000 | ACCE | TED BLE | NE NUMBERS | | | | Т | NITROGEN C | ONTENT | | TARCH | STABIL | JTY (134 | .5°C) | |
| <u>C</u> - | -15333 | | | | | | ····· | \dashv | | | (45 | .5°C) | | | | |
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| | | | *************************************** | | | | | 7 | AVG | <u> </u> | | _ ; | EXPLOSI | | HR | |
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| TEMPERA FROM | IDSES , C | 1 | | PROCE | SS-SOLV | E:IT | RECOVI | RY | AHD DRY | ilig | | | DA | rine IS I | HOURS | |
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| 74 76 C ting Cycle 2 56 62 Post Coating Water Dry 48 | | | | | | | | | | | | | | | | |
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| | FORMULA TOLERANCE | | | | | | | | | 7 7 17 | 276 | FORM | | 701 | | |
| | | | | 95.95 | Remaind | ler | 96.2 | | HEAT TEST | | | | | | C 60 | |
| Diphenyl | + | $\frac{0.8}{0.8}$ | | No Expl | | | 5 hr | | 5 hi | | | | | | | |
| Potassium Sulfare1.0±0.3Methyl Centralite2.15Nominal | | | | | | | 1.9 | | No. Per | | | Type 7 | ٠ | Cylir 7 | ider | |
| TOTAL | Jeneratt | | | 100.00 | 30mina. | | 100.0 | _ | Heat of | | | | | | | |
| Graphite | | | | 0.40 | Max | | 0.2 | | cal/s | | 5,010 | 900 | nom | 910. | .7 | |
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| Residual | l Solven | ts | | 1.7 | Max | | 0.3 | 2 | g/cc | | | 0.92 | | | | |
| Moisture | 2 | | | 1.10 | ±0.40 | | 1.0 | 6 | Loadabi | lity, | ደ | > 97 | 5 No | n 93. | 6 | |
| Hygrosco | ppicity | | | 1.80 | Max | | 0.9 | | | | | | | | | |
| Dust & I | foreign | Matte | r | 0.10 | Max | + | 0.0 | 6 | | | | | | | | |
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R. A. Williams

J. E. Bland

| | | | | SE L | SED FUR G | UV | ENNMENT | URP | OSES ONLY | | | | | | |
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| COMPOSITIO | 25 | | Sushma | | السسم بالرجوب | - | | 0/ | LOT NUMBER | RAD | -PE | | -22(A) | | |
| SPECIFICATION COR | N1tr SAR | RA-I | E, da | ted 30 0c | tober 19 | 950 |) | PA | CKED AMOUN | 95 | 1bs | • | | | |
| MFG AT RA | OFORD A | RMY | AMMU | 19 KOITIN | ANT. RAD | FO | RD. VA. | co | NTRACT NUME | DA DA | AAO | 9.77. | C-400 | 17 | |
| | | | ***** | | | | ELLULOS | Ē | | | | | | | - |
| C-1 | 5333 | ACCI | P'ED BL | ND NUMBERS | | | | | NITROGEN C | ONTENT | | ARCH | STAB | ILITY (| 134.5°C) |
| | | - | | | | | | ᅱ | MAX | % | (65. | .5°C) MIN | | | MIN |
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| | | | | SANIF | ACTURE O | 16 | SOLVENT | PR | OPELLANT | | | | EXPLOS | ION | HR |
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| FROM | TO | Mark | | | | | | IVERY AND DRYING DAYS | | | | | | NYS . | HOURS |
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| 74 | 76 | | ting | | | | | | | | | | | | 2 |
| 56 | 1 40 | | | | | | | | | | | | | | |
| | PROPELLANT COMPOSITION TESTS OF FINISHED PROPELLANT STABILITY AND PHYSICAL TESTS | | | | | | | | | | | | | | |
| | CONSTITUENT PERCENT TOLERANCE MEASURE NICTOCELLULose 96.00 Remainder 96.78 | | | | | | | | | D 12/ 6 | | | AULA | | CTUAL |
| | Nitrocellulose 96.00 Remainder 96.78 Diphenylamine 0.90 ± 0.40 0.93 | | | | | | | | HEAT TEST S | | 2 (| 5 hr | | | CC 60 |
| | Potassium Sulfate 1.0 ± 0.3 0.90 | | | | | | | - | FORM OF PE | | \dashv | Type | | _ | linder |
| | Centralit | e | | 1.5 | Nominal | | 1.35 | | No. Per | foratio | ns | 7 | | | 7 |
| TOTAL | | | | 100.0 | | | 100.00 | | Heat of | | iop | | | | |
| Graphite Total Vo | e atiles | | | 0.40 2.90 | Max Max | | 0.31 | | cal/ Bulk De | | \dashv | 900. | 5 non | 1929 | <u>}.0</u> |
| | l Solveno | S | | 1.7 | Max | | 0.34 | | g/cc | | \dashv | 0.92 | min | ta.s | 91 |
| Moistur | | | | 1.10 | ± 0.40 | | 0.93 | | Loadabi | | | 5.97. | on C | n 94 | .5 |
| Hygrosco | opicity Foreign \ | | | 1.80 | Max_ | | 0.88 | | ļ | | -4 | | | ╄- | |
| Dust & | tokerau v | lact | er | 0.10 | Max | | 0.03 | | | | -+ | | | ┼ | |
| ****** ****************************** | C | LOSE | 0 80.1 | 8 : | | | P-7(| ÞE | LLAHE DE | EHSION | S | inci | iesi | ٠ | • |
| | BMUN TC1 | FR | TEMP ' | I CHICKINESS | FORCE | | | | | | | | |). DEV. | . in % mensions |
| | ?E-559-22 | _ | | | 100.99 | | | | PECIFICATION | DIE | | IISHED | SFEC | | ACTUAL |
| KAD- | PE-559-22 | LAP | 1 158 | 112.67% | 101.44% | | | | 062 nom 949 nom | 0.110 | _ | | 6.25 | | $\frac{2.72}{1.15}$ |
| - 242 | \E | | | | | - | | | 054 nom | 0.012 | _ | | 0.43 | DATE | |
| STA::DARD | 559-15 | (AP | ÷90 | 100.00% | 100.00% | Ţ.j | eb | | | | | | | | • |
| REMARKS | | | | | 1 | <u> </u> | Outer | | | 0.0200 | | | | | |
| | | | | | | ┝ | Inner Avg | 7 0 | 196 nom | 0.0355 | 10. | 0194 | TEST FIL | VISHED | /4/80 |
| | g density closed bo | | 0.2 g | g/cc in 2 | 00 сс | W. | b Difference | | | • | | | | | |
| (HOM) | crosed bo | OMO | | • | | ei Li | Web Avg. | | max 9 - 1.3 | -55.86 | 1. | | DESCRI | | .6/81 |
| 1 | | | | | | D:6 | | | .6 nom | | | .37 | FORWA | RDED | |
| TYPE OF PACE | KING CONTAIN | er F | IBER | DRUM 6521 |): 1 @ 9 | | | | and 5-p | cund sa | | | | | |
| REMARKS | | | | • | | | | | | | , | | | | |
| Chemical | l test re | en11 | e cor | rected f | or TV o | ~~ | phito d | 1 | t and for | | | | | | |
| This lot | Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower | | | | | | | | | | | | | | |
| than des | ired. | | · | | | | | | | | - | | | | |
| SIGNATURE O | HONATURE OF CONTRACTOR S REPRESENTATIVE SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE | | | | | | | | | | | | | | |
| | | 46 | | | | | | | | | ~KAN | ise REP# | Aimses | 14 E | |
| R. A. W | Illiams | Lan | d | | | | | | , | | | | | | |

| | ח | 200 | | ANT UE | FORMATION ED FOR GOV | CONTAINED | PRECE | ES ONLY | | | REPORT | s cont PT-P | KOL S | JOPWI |
|----------------------|---|-------|-----------|----------------------------|-------------------------------|--------------------------------|--------------|--------------|---------------|----------------|----------|---------------------|----------------|-----------------------|
| | <u> </u> | RUP | ELI | LANT UE | 361117 | 110.1 21 | TEE | . 1 | | | | R 335 | | |
| COMPOSITIO | 25m | m Bu | shma | ster | | | DA | LOT MUMBER | RAD | -PE | -559-2 | | | |
| SPECIFICATION COR 1 | | -IE. | dat | ed 30 Octo | ber 1980 | | PACI | KED AMOUN | 96 | 1bs | . net | | | |
| | | | | UNITION PL | | | CON | TRACT NUMB | FD | | 9-77-0 | | 7 | |
| | IDI OND XI | 11111 | M III III | UNITION FL | | | 1 | | UA | AAU | 3-11-0 | -400 | <i>'</i> | |
| | | 1.555 | 47CD 0 | LEND NUMBERS | MILK | OCELLULOS | _ | | | | | . | | |
| | | ACCE | PIEU B | YELD HOWDERS | | | ' ' | NITROGEN CO | ONTENT | | .S*C) | STABIL | .ITY (1: | 34.5°C) |
| C- | 15333 | | | | | ···· | ^ | AX | % | | MIN | | | MIN |
| | | | | | | | ^ | IIN | <u> </u> | , - | MIN | | 20. | MIN |
| | | | | | | | ^^ | vg 13.1 | .3 % | 45- | - mini | | 30+ | МІМ |
| | | | | : • • • • • • • | ACTUSE O | 7 117 11 10 2 | l_ | | | | | 'LOSI | ON | HR |
| 0.92 | · | | | | | F SOLVENT | | | | <u>.</u> | <u> </u> | | <u></u> | |
| ether | , POUNDS SOL PER 100 POUN | | | UND NC/DRY WE | GHT INGREDIE TAGE REMIX TO | _ | | <u> </u> | UNDS ALCO | OHOL | AND | 65 | _ PO | UNDS |
| | ATURES ° C | | | | | IT RECOY | | אסט חויה | 1110 | == | | 1 | irA | |
| FROM | 10 21 | Mode | . r a i · | صب بحد جود میں بروان کا ان | | | | سرون المساور | | | | DAT | 15 | HOURS |
| | 21 | | | n Inert Ga n Inert Ga | | | | | | | | + | - | 32 |
| 21 | 35 | | | e Temperat | | | | | | | ure | + | + | 24 |
| 56 | 62 | Wate | | | <u>للكانة وتبديد</u> | negall 1.4 | | ii rusit | - V S - F F F | 251 | | 1 | 7 | |
| 74 | 76 | | | Cycle | | | | | | | | | | 2 |
| 56 | 62 | | | | | | | | | 48 | | | | |
| PROPELL | INT COMPOSI | 4:!T | 1 | STA | BILITY | AND PH | SICAL 1 | ESTS | | | | | | |
| , | PERCÉN MEASUR | ED | | | | FORM | ULA | A | CTUAL | | | | | |
| Nitroce: | llulose | | | 95.95 | TOLERANCE | | | HEAT TEST S | P 134. | 5°C | No CC | 40' | No | CC 60 |
| Dipheny! | Diphenylamine 0.90 ± 0.4 | | | | | | | No Expl | | | 5 ar | | | T+ NE |
| | ım Sulfa | | | 1.0 | = 0.3 | 0.8 | | FORM OF PR | OPELLANT | | Tvoe | I | Cv1 | inder |
| | Centralit | te | | 2.15 | Nominal | 2.3 | | No. Per | | | 7 | | | 7 |
| TOTAL | | | | 100.00 | | 100.0 | | Heat of | | ie | | | 000 | |
| Graphite Total Vo | | | | 0.40 2.90 | Max Max | 0.3 | | cal/g | | | 900.5 | nom | 890 | 1.3 |
| | l Solvent | | | 1.7 | Max | 0.4 | | Bulk De | nsity, | | 0.92 | min | 1 0 | |
| Moisture | | | | 1.10 | = 0.40 | 1.0 | | Loadabi | lity o | | ₹97. | | | 3.5 |
| Hygrosco | picity | | | 1.80 | Max | 1. , | | | | | | | | |
| Dust & I | Foreign : | latte | er | 0.10 | Max | 0.0 | 5 | | | | | | | |
| | | | | | | | | | | | | | | |
| | | tosa. | | | | المرائغ | <u>ુર્કા</u> | LAUT DI | Elişin: | !\$ | กวกเ | | - | |
| | LOT IVUM | | | F CUICKNESS | ₹₹¥ŢŢŶĘ FQPÇE | | , | | | | | of Me | n Din | in % rensions |
| | PE-559-2 | | | | 98.933 1306.60 | ISNCTH (I) | | CIFICATION | OIE | | NISHED | SPEC. | | ACTUAL |
| KAU- | PE-559-21 | MAP | 1.30 | 37.01% | 22.00% | | | 62 nom | 0.110 | - | . 1043 | $\frac{6.25}{6.25}$ | | $\frac{12.50}{12.01}$ |
| RAD- | PE- | | | | | | | 54 nom | 0.147 | | 0054 | | | |
| STANDARD | 559-15 | (AP | +90 |) 100.00% | 100.00% | Web | | | | | | | DATES | ' |
| REMARKS - | • | | | | | Outer | | | 0.0200 | | | | | /4/80 |
| | | | | | | Inner | | | 0.035 | 0 | .0195 | AM.PLEI | 12 | /4/80 |
| *Loading | density | of | 0.2 | g/cc in 2 | 00 cc | Avg Web Difference | 0.01 | 96 nom | 0.027 | 3 0 | .0186 | EST FIN | ISHED | 16/81 |
| | closed bo | | | 8, | | /Std. Dev. in % of Web Avg. | 20 | max | -55.86 | | | OFFERED | | 16/31 |
| , , | | | | | | LD | 0.9 | -1.3 | | 1 | | ESCRIP | TION S | |
| | | | | | 1 | D·d | | 6 r.om | | 10 | 5.38 | FORWA | KDED | |
| TYPE OF PACE | KING CONTAIN | IER F | IBES | R DRUM 6251 |): 1 @ 9 | 00 lbs. ne | et. | and 6 p | ound sa | amp. | le | | | |
| REMARKS | | | | | | | | | | | | | | |
| This lo | Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower | | | | | | | | | | | | | |
| than de | | | | | | | | | ···· | | | | | |
| سادي نيس | | | | | | | | | | | | | | |
| SIGNATURE C | F CGNIRACTO | RS RE | PRESEN | TATIVE | | SIGNATURE | OF GO | VERNMENT C | NAUTY AS | SURA | NCE REPR | SENTAT | VΕ | |
| R. A. W: | illiams | | | | J. E. | . Bland | | | | | | | | |

| | | | | THE | NFORMATIC | N CONTAINED | HER | EIN SKALL | | | | PE- | |
|---------------|---------------|-------------|-------------|--------------------|---------------------------------------|--|--------------|-------------------|----------|-----------------------------|-------------------|----------------------|-----------------|
| | DI | nan | | MT DE | SED FOR GO | TION SH | urpo: | T ONLY | - | REPO FY F | MPT-P | DL SYA | 130L |
| I | | KUF | CLLF | nii DE | Sunie | 11011 21 | IEE | Į | | | AR 335 | | |
| COMPOSITION | N OF | | | | | | DA L | GT NUMBER | DAD | -PE-559 | النسب المرابط الر | | |
| SPECIFICATION | N | | hmast | | | | PACK | ED AMOUN | | | -20 () | AP) | |
| - C(| OR lette | r SAI | RRA-IE | , dated | 30 Octob | er 1980 | | | 94 | lbs. | | | |
| MEG AT RA | DEORD A | RMY | AMMID | IITION PLA | ANT RAD | FORD. VA. | CONT | RACT NUMS | ER DA | AA09-77 | C-400 | 7 | |
| | er erennemen | | - | | | | <u> </u> | | | | | | |
| | | | | D NUMBERS | · lell H | OCELLULOS | _ | | | | | - | |
| · . | -15333 | ACCE | 11517 9151 | ID MOWRESS | | | N | IITROGEN CO | NIENI | KI STARCH (62.5°C) | STABIL | ITY (134 | i.5°C) |
| | _13333 | • | | | | | ┪ | | _ | • | | | 44:54 |
| | | | | | | | | AX. <u></u> IN | | MIN | į. | | MIN |
| | | | | | | | - " | /G 13 | 13 - | 45+ MIN | | 5+ | MiN |
| | | | | | | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | ─ ^` | /G | * | min | EXPLOSIC | | HR |
| | | | | **** | ACTHEF O | F SOLVENT | pan | PELLANT | | | | | |
| 0.92 | 2011125 501 | VCMT N | 52.001111 | | | ENTS CONSISTING | | | | OUCL AND | 65 | POU | MIIS |
| ether | . PER 100 POU | | | | TAGE REMIX T | | OF | | UNUS ALC | JAOL AND | | | |
| TEMPER | ATURES C | | | | | ENT RECOVI | 27 | AND DRY | ING | | | TIME | |
| FROM | 10 21 | Marie | . F 0 i D | | | f 1/8-inc | | | | ~~~ | CAY | | HOURS |
| | 21 | | | | | f 1/4-inc | | | | | | | 32 |
| 21 | 35 | | | | | $\frac{1}{1}\frac{1}{4}-\frac{1}{1}\frac{1}{4}$ | | | | | | | 24 |
| 56 | 62 | | er_Dry | | ure, mai | HEALH 1/4 | ~ 111C | II TOSIL | IVE II | essure | 10 | | |
| 74 | 76 | | ting (| | | | | | | | | - | 2 |
| 56 | 62 | | | ing Wate | r Drv | | | | | | | | 48 |
| | | | | | | D PROPELLA | UT. | 7 | 574 | BILITY AND P | HYSICAL T | | |
| | ANT COMPOSI | IION | | | | | | لسنن | | | | | |
| 1 | CONSTITUENT | | | PERCENT FORMULA | TOLERANC | | D | | D 12/ | 5"C No (| MULA | | TUAL |
| Nitroce | | | | 95.95 | Remaind | | | | | | | | <u> </u> |
| Dipheny | um Sulfa | r | | 0.90 1.0 | ±0.40 ±0.3 | 0.8 | | No Expl | | | min T | 5 hi | |
| Methyl | | | | 2.15 | Nomi al | | | No. Per | | TVD6 | 3_1 | Cylir 7 | ider |
| TOTAL | Centrali | | | 100.00 | .,000 | 100.0 | | Heat of | | | | | |
| Graphit | e | | | 0.40 | Max | 0.2 | _ | cal/g | | | 5 nom | 910. | .7 |
| | olatiles | · | | 2.90 | Max | 1.3 | | Bulk De | | | | | |
| | 1 Solven | | | 1.7 | Max | 0.3 | | g/cc | | | 2 min | 1.00 | 0 |
| Moistur | | | | 1.10 | ±0.40 | 1.0 | 6 | Loadabi | lity, | g > 97 | 7.5 No | າ 93. | 6 |
| Hygrosc | opicity | | | 1.80 | Marc | 0.9 | 3 | | | | | | |
| Dust & | Foreign | Matt | er | 0.10 | Max | 0.0 | 6 | | | | | | |
| | | | | | <u> </u> | | | | | | | | |
| **:****. / : | Ç | | D 30:1 | | · · · · · · · · · · · · · · · · · · · | P-₹- | 1351 | LANT OF | _E:ISI0: | is line | nesi | - Z. | |
| | LOT NUM | BER | TEMP 'F | CLICKNESS. | RELATIVE FORCE | | | | | | of Me | . DEV. 16 on Dime | n ', nsiens_ |
| | E-559-2 | | | 103.16 | | | | CIFICATION | DIE | FINISHED | SPEC. | | ACTUAL |
| RAD-PF- | 559-20(A | P) | 158 | 112.17 | 101_34 | | | 49 nom | | 0.1047 | 6.25 | | 2.42 |
| | | | | ļ | | | | | | | 10.23 | | 2.23 |
| STANDARD | 559-15 | (AD) | +90 | 100.00% | 100.00% | Web | 0.00 | 64 nom | 0.014 | 0.0066 | 1 | DATES | |
| - | 1 222-13 | (31) | 1.30 | 1 .0000 | 100.00% | Outer | | | 0.0215 | 0.0177 | PACKED | 12/4 | 4/80 |
| REMARKS | | | | | | Inner | - | | 0.031 | 0.0177 | SAMPLE | | |
| *Toadin | a densit | v of | 0.2 | cc in 2 | 00 cc | Ave | 0 01 | 86 nom | 1 | 0.0181 | TEST FIN | | |
| 4 | losed bo | _ | , | 5,7 00 111 1 | .00 CC | Web Difference /Std. Dev. in % | 2001 | .00 11011 | | | 1 | 1/16 | 5/81 |
| (| .10000 | | | | | OT WED AVG. | L | | -30.19 | -3.87 | OFFERED | 1/10 | |
| | | | | | | | 0.9- | | | 1.15 | PORWA | | PEETS |
| | | | | | | 1 | 5 to | | | ji3.75 | <u> </u> | | |
| TYPE OF PAC | KING CONTAL | NER F | IBER I | RUM: 1 | @ 89 1bs | s. net. an | a 5- | ·lb samp | īe | | | | |
| REMARKS | | | | | | | | | | | | | |
| | 1 | | | | | | 3. | | - داد مد | | | | |
| r. | | | | | | graphite, | | | _ | | _ | | _ |
| 5 | | all | speci | ications | with ex | ception t | hat | loadabi | lity i | s somewi | nat lo | wer 1 | inan |
| वेस्डोरस्व | • | | | | | | | | | | | | |
| SIGNATURE C | OF CONTRACTO | CR'S RE | PRESENTA | TIVE | | SIGNATURE | OF GO | VERNMENT C | A YTHAU | SURANCE RE | RESENTAT | IVE | |
| 1 | | | | | | | | | | / - - | | | • |
| R. A. W | Villiams | | | | | J. E. B | land | i | | | | | |

| PROPELLATIT DESCRIPTION STATE EXEMPT-PARA 7-23 AR 335-15 | | | | | | | | | | | | | | |
|--|-----------------|--|--------------------|--|--|------------|-----------------|--|------------|----------------|-----------------|--------------------|-----------------|--|
| COMPOSITION | 25mm B | ushmas | ter | | Annual Control of Control | DA | LOT NUMBER | RAI |)-PE | -559- | 21 (AY |) | | |
| SPECIFICATION | A 712 | 4 | 20. O-n-h- | - 1000 | | PAC | KED AMOUNT | | 1bs | | | | | |
| COR 1ET SARR | | | | | ORD. VA. | CON | ITRACT NUMB | 50 | | | -4007 | ··· | | |
| | | | | | OCELLULOS | Ē | | | | | | | | |
| C-15333 | | CEPTED BL | ND NUMBERS | | | _ | NITROGEN CO | INSTAC | | TARCH .5°C) | STABILIT | TABILITY (134.5°C) | | |
| | | | | | | \square | | 7. | | MIN | | | MIN | |
| | | | | | | | MIN | | | | | | MIN | |
| | | ······································ | | | | ' | wg_13.J | 3_ % | 45 | | 30+ EXPLOSIO | | MIN | |
| | | | | | F SOLVENT | | | | | | | | | |
| | | | | | NTS CONSISTING | OF. | <u> </u> | UNDS ALC | оног | AND | 65 | POU | NDS | |
| ether PER 100 | | OLVENT | | TAGE REMIX TO | | | 1110 001 | | === | | | IIME | | |
| FROM TO | | | | والمرجوب والمسترث | ENT RECOV | | | | | | DAYS | | HOURS | |
| 21 | | | | | <u>of 1/8-in</u> | | | | | | | | 32 | |
| 21 | | | | | <u>of 1/4-in</u> | | | | | | | + | 32 | |
| 21 35 56 62 | - | ncreas ater D | | ture: Ma | intain 1/ | <u>4-i</u> | nch Posi | rive F | res | sure | 10 | + | 24 | |
| 74 75 | | | | | | | + | 2 | | | | | | |
| 56 62 | | | ···· | | | 1 | \dashv | 48 | | | | | | |
| PROPELLANT COM | HT | | ST | ABILITY | AND PH | YSICAL TE | STS | | | | | | | |
| CONSTITU | | | PERCENT FORMULA | TOLERANC | PERCEN MEASUR | | | | | FORM | | | TUAL | |
| Nitrocellulo | | | | Remainde | | ED | HEAT TEST S | F. 134 | . 5 ° | | | | No CC | |
| Diphenylamin | 0.96 | | No Expl | | | | r min | | | | | | | |
| Potassium Su | 0.78 | | FORM OF P | ROPELLAN | | Тур | e I | Cyl | inder | | | | | |
| Methyl Centr | | | 1.00 2.50 | ±0.3 Nominal | 2.77 | | No. Par | forst | ions | 7 | | 7 | | |
| TOTAL | | | 100.00 | | 100.00 | | Heat of | | | | | | | |
| Graphite | | | 0.40 | Max | 0.32 | | cal/g | | | 900.5 | nom | 884 | ·5 | |
| Total Volati | | | 2.90 | Max | 1.41 | | Bulk De | | | 2 22 | | | | |
| Residual Sol | vents | | 1.7 | Max | 0.36 | | g/cc Loadabi | 1.4 | | 0.92 | | <u>ე.9</u> | 95 | |
| Moisture Hygroscopici | +17 | | 1.10 1.80 | ±0.40 Max | 1.05 | | Loadaoi | TITA. | <u>g</u> . | | 1011 | 43. | <u></u> | |
| Dust and For | | atter | 0.10 | Max | 0.04 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 32. C. X. 480. X. | CLOS | ED 301 | ខេ | | FF | 372 | LLAST EI | 16:1510 | :18 | inch | | | | |
| LOT | NU:ABER | TEMP - | المراجع المجاد | 8517,1145 FC 0CE | | | | | | | of Mea | θέν. n Dim | in % ensions | |
| TEST RAD-PE-55 | | | | 99.27% | | | PECIFICATION | DIE | | NISHED | SPEC. | | ACTUAL | |
| RAD-PE-55 | <u> 9-21 (A</u> | <u>PI)+158</u> | 102.23% | 99.98% | | | | D.110 | | 1060 | 6.25 | | 2.39 | |
| | | | | ļ | | - | 949 nom | | | 0905 0064 | 6.25 | | 2.09 | |
| STANDARD E 55 | 9-15(4 | Ph +90 | 100.00% | 100.00% | Web | ٧٠٧ | OUS HOR | 1.014 | ۲: | 5004 | • | DATES | | |
| | ~ 7.0 | <u>., , , , , , , , , , , , , , , , , , , </u> | 1 | | Outer | | | 0.021 | 5 þ. | 0185 | PACKED | 12/ | 4/80 | |
| REMARKS | | | | | Inner | | | p.031 | ρ. | 0181 | SAMPLED | 12 | /4/80 | |
| | | | | | | 0.0 | 186 nom | 0.026 | 3 ρ. | 0133 | TEST FINI | SHED | 6/81 | |
| *L ading den | | | g/cc in 2 | 200 cc | Web Difference /Std. Dev. in % | 20 | max | -36.1 | 9 +2 | | OFFERED | $\frac{-7}{1/1}$ | 6/91 | |
| m) close | ed bomb |) | | | of Web Avg. | ļ | - 1.3 | 1 | | 17 | DESCRIPT | ION S | | |
| i | | | _ | o 15 | | | .14 | FORWAR | DED | | | | | |
| TYPE OF PACKING CO | NTAINFR | FIRED | DRUM: 1 | @ 90 1he | | _ | pound | sample | | | L | | | |
| REMARKS | | | | , ,, 103 | | | | | | | | | | |
| Chemical tes | st tesu | lts co | rrected f | for TV, g | raphite, | dus | t and fo | reign | mat | ter. | | | ļ | |
| This lot mee | ts all | speci | fication | requirem | ents exce | pt | that loa | dabil | ity | is so | mewhat | 10 | wer | |
| than desired | • | | | | | | | | | | | | | |
| | | | | | | | | ···· - · · · · · · · · · · · · · · · · | | · | | | | |
| SIGNATURE OF CONTI | RACTOR'S | REPRESENT | ATIVE | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | SIGNATURE | OF G | OVERNMENT | QUALITY A | SSUR | NCE REPI | RESENTATI | VE | | |
| R. A. Willia | ıms | | | J. E. | J. E. Blard | | | | | | | | | |

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| , | Pl | ROPE | LL | ANT DE | SCRIP | TI | ON SI | ŧΕ | ET | | | EXEN | IPT-PAR NR 335 | ARA 7 | -2a |
|---|----------------------------------|---------------|---------|--------------------|--------------|-------------|------------------------------|----------|-----------------|---------------|------------|----------------|--|------------------|---------------------|
| COMPOSITION | N 25 | mm Bus | hra | ster | <u> </u> | | | DA | LOT NUMBER | RA | D-PE | -559- | 22(AP |) | |
| SPECIFICATION | Alex SAR | DA-TE | dat | ted 30 Oc | tohon 10 | 50 | | PA | CKED AMOUN | 7 | lbs | | | <u></u> | |
| MFG AT RA | DFORD A | RMY AM | MU | NITION PL | ANT, RAD | F 01 | RD, VA. | co | NTRACT NUMB | 50 | | 9-77-6 | C-400 | 7 | |
| | • | | | | | | ELLULOS | E | | | | | | - | |
| ,, | 5333 | ACCEPTE | BLE | ND NUMBERS | | | | | NITROGEN C | ONTEN/ | | TARCH .5°C) | STABIL | JTY (134 | i.5°C) |
| | | | | | | | | _ | MAX | % | | MIN | | | MIN |
| | | | | | | | | | MIN | 7. | | MIN | | | MIN |
| <u></u> | | | | | | | | \dashv | AVG 13.1 | .5 % | 43 | +_ MIN | EXPLOSI | 30+ | MIN |
| | " | | | 32 & 3316 | SCTUDE O | F | THEFT | PR | OPELLANT | | | | EXPLUSIO | JN | HR |
| 0.92 | | VENIT OCR | 2011 | ID NC/DRY WE | | _ | يققد وطنيب بصوحيايها | | | _ | CONOI | AND | 65 | POU | NDS |
| ether | PER 100 POU | | | PERCEN | TAGE REMIX T | 0 W | HOLE | , Ur | | JONUS AL | | ANU | | | |
| | TURES . C | 4 | | | | _ | | 237 | AND DRY | HIC | سامه بيسا | | DAY | (iME | CURA |
| FROM | 7 <u>C</u> 21 | Mainta | in | Inert Ga | | | | | | | ure | | UA) | | OURS |
| | 21 | | | Inert Ga | | | | | | | | | | | 12 |
| 21 | 35 | | | ch Posit | | | ure | | 2 | 4 | | | | | |
| 56 | 56 62 Water Drv 10 | | | | | | | | | | | | | | |
| 74 76 Coating Cycle 2 56 62 Post Coating Water Dry 48 | | | | | | | | | | | | | | | |
| 56 | 62 | Post (| Coat | | | | | | | | | يود 170 بيدات | | | 8 |
| PROPELLA | INT COMPOSI | TION É | | 15313 01 | FINISHE | D F | | | | Si | ABILITY | AND PH | YSICAL 1 | ESTS | |
| | ONSTITUENT | | | PERCENE FORMULA | TÖLERANC | E_ | MEASUR! | ED_ | | | | FORM | IULA | AC | TUAL |
| Nitroce. | | | | 96.00 | Remaind | er | | | HEAT TEST S | P 134 | .5°C | No Co | C 40' | No C | C 60 |
| Dipheny. | | | \perp | 0.90 | = 0.40 | | 0.97 | | No Expl | osion | | 5 hr | | 5 hr | + NE |
| | Potassium Sulfate 1.0 = 0.3 0.90 | | | | | | | | FORM OF P | | | Type | | Cv1i | nder |
| Methyl (| Centrali | <u>te</u> | 4 | 1.5 | Nominal | _ | 1.35 | | No. Per | | _ | | | | 7 |
| TOTAL | | | ┿ | 100.0 | | | 100.00 | | Heat of | | osio | | | 000 | |
| Graphite | e olatiles | | -+- | 0.40 2.90 | Max Max | | 0.31 1.27 | | cal/ Bulk De | | | 900. | j nom | 929. | <u>U</u> |
| | l Solven | | + | 1.7 | Max | \neg | 0.34 | | 2/cc | | 2 | 0.92 | min | 0.99 | 1 |
| Moisture | | | + | 1.10 | ± 0.40 | | 0.93 | | Loadabi | | 2 | <u>\$</u> 97. | מסת | n 94. | 5 |
| Hygrosco | | | | 1.80 | Max | | 0.88 | | | | | | | | |
| Dust & | Foreign | Marter | | 0.10 | Max | | 0.03 | | | | | | | | |
| | | | | | | ل | | | | | | | | | |
| | | LOSED | | | - | - | Pat | 172 | LLAST DI | "Elisii | INS | inci | | A. 214 | - |
| | LOT NUM | | | 1 CUITANESE | FORCE | <u> </u> | ~~~~~ | | | | | | of Me | . CRV. II | ntiont |
| | PE-559-2 | | | 1101.48% | 100.99 | <u> </u> | - 7/11 | | PECIFICATION | DIE | | NISHED | SPEC. | | ACTUAL |
| RAU- | PE-559-2 | ZIAPD | 58 | 112.07% | 101.44% | | METER (D) | | 062 nom | 0.11 | | 1058 | 6.25 | | $\frac{2.72}{1.15}$ |
| | | - | | | | | | _ | 054 nom | 0.01 | | | 0.23 | | 1.17 |
| STANDARD | 559-1 | 5(AP) - | -90 | 100.00% | 106.00% | W | eb | 1 | , | 10.00 | - 1. | V 20 | | DATES | |
| REMARKS | · | | | | | | Outer | | | 0.02 | 00 0 | .0173 | P .CKED | 12/ | 4/80 |
| UPHUNKS. | | | | | , | | Inner | | | 0 03 | 55 0 | 010/ | SAMPLE | D 12/ | 1. 190 |
| AT codin | . denete | w of O | 7 . | g/cc in 2 | 00 00 | | Avg | D.C | 196 nom | 0.02 | 78 C | .0194 | TEST FIN | SHED | /81 |
| | closed b | | ٤ 2. | 3/1:C III 2 | 00 66 | /Sh | b Difference d. Dev. in % | 20 |) max | 1 | | 11.81 | OFFERE | $\frac{1}{1/16}$ | /81 |
| (nom) | crosed 0 | ОЩО | | | | じ | Web Avg. | | 9 - 1.3 | -55. | | .18 | DESCRIP | | |
| | | | | | | 0:0 | | | .6 nom | † | | 5.37 | FORWA | RDED | |
| TYPE OF PAC | KING CONTAI | NER FIR | ER | DRUM 6521 |): 1 a | | lbs. ne | | and 5-p | ound | | | | | |
| REMARKS | | | | | | | | | | | | | ······································ | | |
| | | | | | | | | | | | | | | | |
| Chemica | l test r | esults | COI | rrected f | or TV, g | ra | phite, | dus | st and fo | reign | mar | ter. | | _ | |
| | | all spe | cif | ication | requirem | en | ts exce | pt | that loa | dabil: | ity : | is son | newhat | : low | er |
| than des | ired | | | | | | | | | - | | | | | |
| SIGNATURE C | F CONTRACTO | RS PSORS | SENT | ATIVE | | _1 | SIGNATURE | OF O | OVERNMENT | CUALITY | A S SLID A | NCE REPE | ESENTAT | IVE | · |
| | | | | | | ļ | | | | ~~~ #! | | | | | |
| R. A. W | illiams | | | | | , _[| J. E. B | lar | nd | | | | | | |

| | | | | THE IN | ECOMATIC | N CONTAINED | HFO | FIN SHALL | | | | خصصت | _ | سحد سائدت |
|---|--|-------------|--------------|-----------------------|--------------------------|-----------------------------------|-------------|------------------|-----------------|---------------|---------------|---|-------------|-------------------|
| | PR | ROPI | ELLA | SE US | SUILLY | VERNMENT PL | RPO | SES ONLY | | | ! EXEN | PT-PAR 335 | ARA | 7-2a |
| COMPOSITIO | N 25mm | n Bus | hmast | er | | | DA | LOT NUMBER | RAI |)-PE | -559- | | | |
| SPECIFICATION | | | | • | ber 1930 | | PAC | KED AMOUN | | | . net | | · | |
| MICAI | DFORD AR | | | | | | CON | TRACT NUMB | CD | | 9.77.0 | | 7 | , |
| | IDI UND AN | 11111 | 111111111111 | 1111011 1 27 | | OCELLULOS | F | | | | 3-11-0 | 7-400 | | |
| | | ACCEP | TED BLEF | ND NUMBERS | 11111 | OGELEGEOS | | NITROGEN CO | ONTENT | KIS | TARCH | STABIL | IIY (I | 34.5 °C) |
| | | | | | | | 4 | | | | 5.5°C) | | ••• | |
| C | 15333 | | | | | | _ | MAX | % | | MIN | | | MIN |
| | | | | | | | | MIN | 3 ~ [| 45 | MIN | | 30+ | MIN |
| | ···· | | | | | | ' | 1v6 | * | | W114] | EXPLOSI | ON | MIN HR |
| | | | | MANUF | ACTURE O | F SOLVENT | PRI | OPELLANT | | | | | | |
| 0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 35 PUNDS ALCOHOL AND 65 POUNDS ETHER PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 0 | | | | | | | | | | | | | | |
| | | DS SOLV | /ENT | | | | | | | | | | 1.5 | |
| FROM | ATURES ' C | | | | | ENT RECOY | | | STREET, SQUARE, | | | DAY | | HOURS |
| | | | | | | f 1/3-incl | | | | | | - | | 32 |
| 21 | | | | | | f 1/4-inci | | | | | | | | 32 |
| 21 35 Increase Temperature, Maintain 1/4-inch Positive Pressure 24 56 62 Water Dry 10 | | | | | | | | | | | | | | |
| 74 76 Coating Cycle | | | | | | | | | | | | 1 | 2 | |
| 56 | | | | ing Wate | r Drv | | | | _ | | | 1 | | 4.9 |
| PROPELL | ANT COMPOSITI | | į | | | PROFELLA | ::IT | . (| ST | ABILITY | AND PH | YSICAL T | ESTS | |
| (| CONSTITUENT | | | FERCENT FORMULA | TOLERANCE | PERCÉN MEASURI | 0 | | | | FORM | ULA | | CTUAL |
| Nitroce. | llulose | | | 95.95 | Remaind | | | HEAT TEST S | 5°C | | | Vo. | CC 60 | |
| Dipheny | | | | 0.90 | ± 0.40 | 0.9 | | No Expl | | | 5 hr | | | r+ NE |
| Potassi | um Sulfat | e | | 1.0 | = 0.3 | 0.80 | | FORM OF PR | | | Tvoe | I | Cv1 | inder |
| | Centralit | .ē | | 2.15 | Nominal | 2.3 | _ | No. Per | | | | | | 7 |
| TOTAL | | | | 100.00 | V | 100.00 | _ | Heat of | | sic | | | 000 | |
| Graphite | e olatiles | | | 0.40 2.90 | Max Max | 1.4 | | cal/g Bulk De | | | 900.5 | nom | 890 |).3 |
| | l Solvent | s | | 1.7 | Max | 0.4 | _ | 8/cc | usity, | | 0.92 | min | 1.0 | 03 |
| Moistur | | | | 1.10 | = 0.40 | 1.0 | | Loadabi | litv. | ₹. | ₹97. | | | 3.5 |
| Hygrosc | opicity | | | 1.30 | хеľ | 1.4 | 5 | | | | | | | |
| Dust & | Foreign 1 | atte | <u>r </u> | 0.10 | Max | 0.0 | 5 | | | | | | | |
| ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | | | | | | ا | | | | | | | |
| 7 : | _ | | 30 | | SELAT VE | <i>*.</i> ** | 1761 | LA.IT DI: | £118111 | (15 | linen | | DEV. | in % |
| erer DAD | LOT NUMBI PE-559-23 | | | Lovickness 35.42.4 | <u>`ĔŎŶĊĔĔ</u> 98.93. | | | ECIFICATION | | 7 - | | | n Din | in 2, nensions |
| | PE-559-23 | | 158 | 97.61/3 | | | | 062 nom | 0.110 | | NISHED . 1043 | 6.25 | | 12.60 |
| | | | | | | DIAMETER (D) | | 949_nom | 0.147 | - | .0888 | 6.25 | _ | 12.01 |
| RAD- | | | | | | | |)54 ncm | 0.012 | | .0054 | 4 | DATE | |
| STANDARD | 559-15 | CAPL | +90 | 100.00% | 100.00% | Web | | | 0.000 | 4 | | | | 11 100 |
| REMARKS . | - | | | | | Outer Imaer | | | | | .0177 | | | |
| | | | | | | |), 01 | 196 nom | 0.033 | 310 | .0186 | TEST FIN | SHED | /4/80 |
| | g density | | 0.2 g | cc in 20 | 00 cc | Web Difference /Std. Dev. in % | | | -55.8 | | | | | 16/81 |
| (nom) | closed bo | mb | | | | of Web Avg. | | max | -33.0 | | | OFFERED CESCRIPT | | 16/81 |
| | | | | | | ĿD | _ | 9-1.3 | | | <u> </u> | ORWAR | | 24. F12 |
| ************************************** | VIND 44 | | | DRIPE COST | | D:d | | .6 nom | <u></u> | 1 | · ~ | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | and the Can | 2200000 |
| REMARKS | KING CONTAIN | ER ? | LBEK | DRUM 623L |): 1 (4) | 90 lbs. ne | E. | and o po | ound s | amı | · | | | |
| | 1 test re | sult: | s cor | rected fo | or TV. o | raphite, d | inet | t and fo | reion | mat | tar | | | |
| This lo | t meets a | 11 s | pecif | ication | requirem | ents excer | יד t | that load | dabili | ty | is sou | ewhat | : 10 | wer |
| than de | | • | - | | - | • | | | | • | | | | |
| | | | | | | | | | | , <u></u> | | | | |
| SIGNATURE | IGNATURE OF CONTRACTOR S REPRESENTATIVE SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE | | | | | | | | | | | | | |
| | MINITURE OF COMMISSION 2 NO RESERVANCE REPRESENTATIVE | | | | | | | | | | | | | |
| R. A. W | illiams | | | | | J. E. 1 | Blar | nd | | | | | _ | |
| RRCOM | FORM 214R | 10 4 | UG 77 | | | 174 | | | | | | 7.44 | | |
| | | | | | | | | | | | | | | |

APPENDIX G

GUN TEST RESULTS

PROPELLANT BALLISTIC REQUIREMENTS 25mm APDS CARTRIDGES

-2048 contract

 $\sqrt[7]{v}$ + .72\$ ≤ 1356 (21°C), $S \leq 10$

Avg = 1341 m/s

ADMS-567895 Spec

vo - .728 ≥1326

Gia AP v + ,728 ≤399 (21°C)

 \vec{P} + 5.14S ≥ 496 (-54 +71°C)

-0010 contract

 $Vo = 1350 + 15 (21 C) \cdot S \le 10$

Avg = 1350 m/s

AS12013532 Spec 12013535 drawing 77.91

 \bar{P} + 3S \leq 454 (21°C)

135 Gm AP

 $\bar{P} + 3S \leq 496 (71^{\circ}C)$

Oerlikon WSW 62010D $\overline{\text{Vo}} + .72 \text{ S} \le 1375$ (_21°c), $\text{S} \le 10$

Avg = 1360 m/s

Vo - .72 S≥13+5

 $\bar{P}_{C} + 0.72 \text{ S} \leq 392 \text{ MPa}$

Jm AP

P_C + 5.14 S≤ 490 MPa

PROPELLANT

HIS TOPY/DIRECTION

- Redford 559-15 selected in 1978 using 1340 M/s velocity criteria. Prop±1lant has 0.5 percent K₂SO₄ flash suppressant. Specification ADMS-567895 was applicable.
- 2. Sept. 79 Projectile velocity increased to obtain Sushmaster specification penetration $1340 \rightarrow 1350$ k/s
- 3. Aug. through Oct. 79 Muzzle blast and flash defined as a problem by the user. One-half gram KNO₃ added to solve problem. Increased pressure with RAD-559-16.
- 4. <u>Jan. 80</u> Specification AS12013532 (P̄ + 3 s.d. ≤ 496 at 71°C and 1350 ± 15 m/s) and drawing 12013535 in effect. FACC recommended: (ref. 1stter 0E-80-910, 18 Jan. 80) to user:
 - a. Make and test propellant with salt before propellant " awing changed.
 - b. Make and test four pilot lots of two webs (increased) and two coating levels to increase the propellant progressivity and reduce pressure.

Note: Recommendation 44 was not accepted.

Recommendation 4B was accepted for partial implementation.

- 5. June 80 Drawing 12013535 changed per direction to incorporate 1.0 percent total $K_2 \le 0_4$ (in propellant).
- 6. Aug. 80 Lot RAD 359-17 with 1 3% K₂SO₄ (increase of 0.5%) was received and tested. Pressures were high and propellant returned to Radford for addition of more coating, blending and shipment sack to FACC.
- 7. Oct. 80 Let RAD 559-17 (B) received and tested. Lot was improved but still pressures were too high at +71°C.
- 8. Oct. 80 Lot RAD 559-18 and -19 received and tested. It was determined by Radford after shipment that the lots were contaminated with DNT. The propellant also had not been configured as specified as recommended (Ref. 48).

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES CHLY

- RAD-559 les 19 was too slow, and lot 18 was better but the configuration and contemination were significant departures from the configuration in the 12013535 drawing.
- 9. Oct. 80 Meeting at FACC. Radford was directed to proceed with another four pilot lots (two webs and two coatings of each web) in an attempt of retune the configuration. Radford lot 559-15 was established as a reference powder for closed bomb purposes. Closed homb results were to be used for comparisons since Radford was not able to perform ballistic firings.
- 10. Dec. 30 through Jan. 81 Received and tested Radford 559 lot -20, -21, -22, and -23. Retermined that due to last minute reblending performed at Radford before shipment, the loading density was effected and was too low (approximately 93 percent of nominal). Ballistic data here obtained by overloading and vibrating the case and charge. Radford lot -21 showed promise if the charge loadability could be increased.
- 11. Jan.81 Meeting at Radford for definition of redirection for the next lot RAD-559-24. RAD-21 was to be copied but with increased loadability. Salt level to be maintained at 1.0%.
 - 12. Apr. 81 RAD lot 559-24 received at FACC and tested. This lot was too slow and was also found to be contaminated with other propellant pieces. Blended samples of RAD-17 (too fast) and PAD-24 were tested at FACC, and a 25 percent RAD-24 and 75 percent RAD-17 extrapolated to a better solution.
 - 13. Apr. 81 Meecing at Radford to redirect future efforts. FACC presented the ballistic results of the RAD-24/17 blends. Radford was directed to repeat the blends using the full capacity blenders and ship the samples to FACC for ballistic tests. Radford was directed also to equip themselves, with help from FACC, to ballistically fire 25mm APDS-T ammunition by Jul. 1981. No changes to the specifications were equested by Radford personnel. Radford was also directed, when processing or the 20,000 lb. mid-July lot, to provide "high" and a "low" coated batches which would be blended to provide the proper coating.

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

- 14. June 81 FACC received blended RAD lots 559-26, -27, -28, -29, and -30. FACC also received two samples from the 20,000 pound lot for mid-July delivery. These samples were to be one "high" and one "low" for blending purposes. The five blended samples were ballistically tested at FACC. Of those samples fired, three were fairly close together in performance but all were high in pressure at ambient temperature. The "low-high" samples from the 20,000 pound lot were even higher and had to be fired with 4 to 5 granted and charge weights.
- 15. July 81 FACC compiled the data from (14) above and transmitted to interested government agencies prior to meeting at FACC on 7 July 1981.

FACC

RECOMMENDATIONS:

GOVERNMENT:

- 1. Provide funds to Radford to establish ballistic capability, evaluate Dutch properlant and establish 20,000-pound lot as deliverable.
- 2 Implement second source work directive on STS contract.

RADFORD:

- 1. Establish ballistic capability.
- 2 Evaluate Dutch lot MC 07-78 in closed bomb and Mann barrel.
- 3. Establish limits of propellant parameter for blending of two segments of 20,000-pound lot.

FACC:

- 1. Investigate RAD-18 and Dutch lot 07-78 further over temperature range against AS12013532 requirements.
- 2. Establish a more accurate relationship between chamber pressure and case mouth pressure. Ten percent may be too large.
 - o Include Oerlikon P_C location in Evaluation (approximately 20mm difference between Oerlikon and CONUS pick-up locations).
- 3. Re-establish pressure differential for new Octlikon pressure transducer location.

25mm APDS HOT-COLD PRESSURE DIF. RENTIALS

| Test Location | FACC | FACC | FACC | FACC | FACC | Oerlikon 5/14/81 |
|---------------------------|------------|------------|----------------------|-------------|-------------------|------------------|
| AMPa | (11) | (E) | (P) | (48) | (2) | (3) |
| MPa +21 ^o c | 395 | 420 | 404 | 411 | 383 | 414 |
| MPa +710c | . 506 | 505 | 482 | 495 | 786 | 501 |
| Lot . | RAD-16 (S) | RAD-17B | RAD 24:17 25%/75% | RAD-28 | Dutch MC-07-78 | RAD-16 (S) |
| Wt. | 98.0 | 0.66 | 0.06 | 0.86 | 98.5 | 7.66 |

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

25mm FCREIGN PROPELLANT COMPARISONS

| | | • |
|-----------|------------------------------------|----------|
| WS P-2078 | | MC 06-78 |
| 0.158" | Length | - 0.128" |
| 0.094" | | |
| 0.0063" | Inner Diameter | |
| | Web Thickners | |
| | RQRadford | |
| 100% | RF Radford | תפת. |
| 97.94 | NC, % (13.2%) | 100 |
| 1.03 ———— | DPA, % | |
| | K ₂ SO ₄ , % | |
| | 2004 | 0.9 |
| | Ethyl Centralite, 2 | 1.4 |
| 3.0% | Camphor,2 | 0.8% |
| 0.1 — | Graphite,2 | 0.1 |
| | Moisture,% | |
| | Alcohol, 2 | |
| | Ether,% | |
| | Grav. Density, grace | |
| A 3 | | 0.999 |
| 0./ | RS,% | 0.8 |
| 1.9 | TV, % | |
| 928 ———— | HOE, Cal/3m. | 906 |

DUTCH 25mm AP PROPELLANT

BALLISTIC RESULTS IN M791 DESIGN

| | 10: 10. | Charge Weight | <u> </u> | MPa PC. | ₹ <u>8</u> | P _C + 3° 3d | Vo, m/s | vo, | Temp. | Remarks |
|-----|-----------------|------------------|----------|------------------|-------------|---------------------------|------------|-----|-------|-----------|
| MU | 35-75 | 98.0 | 5 | 395 | 4.1 | 407 | 1337 | 3.3 | ÷28 | ATP-1525 |
| tu. | ;, - , 3 | 27 J | > | → & ✓ | 1.3 | ÷15 | 1349 | 1.5 | +28 | ATP-1525 |
| w(, | 27-79 |) | 9 | 383 | 3.2 | 393 | 1331 | 1.2 | 1.21 | ATP-1532 |
| ¥1, |) * • * 9 | ¥4 5 | :3 | -3 5 | a. 5 | <u></u> \$በበ | 1397 | 3.7 | +71 | ATP-1532. |

| Data | ectile |
|--------|--------|
| istic | Proje |
| Ball | PDS-T |
| Lot | gram A |
| PE-559 | 135 g |
| SAD P | vith |

| ATP-1338, retest ATP-1347 ATP-1348 | LAT PFC81A004-002 LAT PFC81A004-002 | PFC80£004-001 793002 H003 LAT ATP-1283 - Pressure high | ATP-1307 (0.3% more costing) | ATP-1307 (0.3% more coating) | ATP-1310:Contaminated, and larger configura-tion | ATP-1300: Flash, too slow | ATP-1354:Low loadability, reblended. | ATP-1354;Low loadability, reblended. | ATP-1354:Low loadability, reblended. | ATP-1354:Low loadability, reblended. | ATP-1443, Too slow and propellant contaminated | ATP-1443, Too slow and | |
|--|--|--|------------------------------|------------------------------|--|---------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--|------------------------|--|
| Temp., oc. +21 +21 +21 | +21 +71 | +21 21° +21 | +21 | +71 | +21 | +21 | +21 | +21 +21 | +21 | +21 | +21 | +21 | |
| Vo. 8 d 3.0 3.5 2.8 | 5.9 | 5.4 | 3.0 | 3.2 | 6.6 | | 12.2 | 2.8 | e. E | 9.5 | 2.4 | 3.7 | |
| Vo, m/8 1353 1332 1341 | 13.2 | 1350 1348 1344 | 1350 | 1399 | 1342 | 1231 | 1319 | 1264 1327 | 1349 | 1231 | 1305 | 1317 | |
| Pc + 3Csd 441 4114 415 | 417 (546) | (467) .401 (459) | 447 | (533) | 452 | t | 422 | 332 .• 401 | 454 | 320 | . 397 | 414 | |
| Ps. 4.8 | 7.3 | 11.6 7.7 10.0 | 9.0 | 9.5 | 23.6 | 3 | 5.3 | 3.4 | 7.4 | 10.3 | 6.9 | 0.80 | |
| Avg P P MBa 427 389 396 | 395 506 | 432 378 429 | 420 | 505 | 381 | 323 | 905 | 322 386 | 432 | 289 | 376 | 390 | |
| تار 0 <u>.</u> | 02 6 | 07 | 1.4 | 1.0 | ហ | ო | Ŋ | ហេស | Ŋ | S | ß | ĸ. | |
| Charge Wt. 5 99.0 98.5 | 98.0 | 99.7 99.7 99.0 | 99.0 | 0.66 | 100.0 | 100.0 | 92.0 | 92.8 97.0 | 0.46 | 93.0 | 99.0 | ט טטנ | |
| RAD 1.0c No. -15 -16 | -16s -16s | -16s -17 | -17B | -17B | -18 | -19 | -20 | -21 -21 | -22 | -23 | -24 | 6 . | |

| ATP-1/43, Too slow and propellant contaminated | ATP-1443, Too slow and propellant contaminated | ATP-1467, Blend: 25%/75% ATP-1467, Blend: 25%/75% | ATP-1460, Blend: 50%/50% | ATP-1407B, 20,000 lbs | ATP-1507A, 20,000 1bs preblend. | ATP-1496,10%/90%, 24:17 | ATP-1496,20%/80%, 24:17 | ATP-1496,25%/75%, 24:17 | | ATP-149/, 25%/15%, 24: 11 | ATP-149/, 25%/15%, 24:1/ | ATP-1496,30%/70%, 24:17 | ATP-1496,? | 1310 | | AIF-1538, 1310 Ferest |
|--|--|--|--------------------------|-----------------------|------------------------------------|-------------------------|-------------------------|-------------------------|------|---------------------------|--------------------------|-------------------------|------------|------|-------|-----------------------|
| +21 | +21 | +21 +71 | +21 | +21 | +21 | +21 | +21 | +21 | +21 | +71 | - 54 | +21 | +21 | +21 | +21 | +71 |
| 3.7 | 2.5 | 3,8 | • | 6.5 | 1 | 5.6 | 4.5 | 4.2 | 5.8 | 5.4 | 9.9 | 1.7 | 6.4 | 6.4 | ທຸ | 3.7 |
| 1317 | 1331 | 1337 1385 | 1325 | 1354 | 1399 | 1359 | 1360 | 1355 | 1339 | 1392 | 1260 | 1359 | 1370 | 1325 | 1335 | 1387 |
| 414 | 420 | 425 489 | 403 | (466 | . | (429) | (458) | 443 | 431 | (516) | 347 | 453 | (481) | 430 | 437 | 470 |
| 8.0 | 4. 8 | 6.9 | | 3.4 | 1 | 5.6 | 5.3 | 3.2 | 7.0 | 7.1 | 9.1 | 4.9 | 6.9 | 11.2 | 13.1 | · · · |
| 390 | 907 | 404 | 389 | (456) | (526) | 442 | 442 | 433 | 411 | 495 | 320 | 438 | 760 | 396 | 398 | 450 |
| 2 | 10 | 20 | 7 | 'n | 7 | Ŋ | \$ | ٧ | 10 | 01 | 10 | 8 | יבי | v | ง | 'n |
| 100.0 | 101.5 | 99.0 99.0 | 0.66 | 95.0 | 0.96 | 0.66 | 0.66 | 0.66 | 98.0 | 98.0 | 98.0 | 99.0 | 99.0 | 99.0 | 100.0 | 100.0 |
| -24 | -24 | -24:17 ACC | -24:17 FACC | -25A | -25B | -26 | -27 | -28 | -28 | -28 | ~28 | -29 | -30 | -18 | -18 | -18 |

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Suffix S means 0,5 grams of powdered KNO3 added to propellant.

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APPENDIX H

PRODUCTION ENGINEERING INVESTIGATIONS (PEI-559-17 through 19)

SPECIAL OPERATING INSTRUCTIONS

I. MATERIALS MANAGEMENT

A. Materials Control

Following is a list of materials required for the manufacture of 25mm propellant:

| Nitrocellulose (13.15%N) | MIL-N-244 Type I, Grade C |
|--------------------------|------------------------------|
| Diphenylamine (DPA) | MIL-D-98 |
| Potassium Sulfate | MIL-P-193 |
| Graphite | MIL-G-155 |
| Methyl Centralite* | MIL-M-19719 |

^{*}Must be ground - 97 percent minimum to pass a 70 mesh screen.

II. PROPELLANT DEPARTMENT

Type Propellant: 25mm

Approximately 5,000 pounds - 16 mixes will be required.

| Composition | Spec_f_cation | Percent by Weight | Weight, pounds |
|---|------------------------------|-------------------|----------------|
| Nitrocellulose* (13.15 + 0.05% N: Cotton Linters) | MIL-N-244 Type I, Grade C | 100.00 | 348.0 |
| Diphenylamine (DPA) | MIL-D-98 | 1.00** | 3.5 |
| Potassium Sulfate | MIL-P-1.93 | 1.00** | 3.5 355.0 |

^{*}Use blend with N closest to 13.20 percent. **Based on nitrocellulose weight.

Nitrocellulose requirements are as follows:

| | Acceptable Idmits 40 to 49 percent | | | | | |
|------------|--|--|--|--|--|--|
| Solubility | | | | | | |
| Fineness . | Final Blend: 90 Control: 82 Accept: 77 to 95 | | | | | |
| Freeness | Final Blend: 416 to 550 ml | | | | | |

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| Solvents . | Acceptable Limits |
|---|-------------------------------|
| 92 pounds solvent per 100 pounds dry weight of ingredients | 326 pounds of solvent per mix |
| 65 parts ether per 100 parts solvents | 212 pounds of ether per mix |
| 35 parts alcohol per 100 parts solvents | 114 pounds of alcohol per mix |

A. Chemical Grind

Weigh ingredients as required in accordance with the following:

| Ingredient | Weight/Bag | Tolerance |
|-------------------|-----------------|-------------|
| k2s0 ₄ | 3 15 8 ozs. | +/- 0.3 oz |
| DPA | 3 lbs 8 ozs. | +/- 0.3 oz |
| Graphite* | 10 lbs 0.0 ozs. | +/- 0.3 oz |
| Methyl Centralite | As determined | |

^{*}Graphite weight is based on 5,000 pounds per batch.

B. Nitrocellulose Area

Supply a sufficient quantity of nitrocellulose (13.15 + 0.05% linters) to produce 16 mixes (348 pounds/mix).

C. Dehydration

1. Use General Operating Instructions and the following specific instructions:

| Number of blocks/mix | 4 |
|--------------------------------------|-----------|
| Dry weight of NC per block | 87 |
| Gallons of alcohel per block (min) | 17 |
| Nominal dwell time, minutes | 1 |
| Wet weight of individual blocks, lbs | 104 +/- 4 |

2. Weigh dehy blocks and record individual block weights on flow cards. Identify each mix by NC blend number and type of propellant.

D. Solvent Mix House

1. Use General Operating Procedures for preparing DPA with ether (mixed solvent). Mixture calculated weights of ingredients for preparation of one final mix charge and one solvent mix are as follows:

per 559-17 thru 19

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| Ingredient | One Final Mix, pounds | 16-1/2 Final Mixes, pounds | | |
|---|-----------------------|----------------------------|--|--|
| an degrada properties | - 111 | | | |
| Ether | 212.3 | 3502.95 | | |
| Diphenylamine | <u>3.5</u> | 57.75 | | |
| TOTAL | 215.8 | 3560.70 | | |

2. A laboratory analysis must be performed on each tank of solvent mix. The laboratory sample must meet the following requirements:

| Ingredient | Percent Ingredient |
|---------------|--------------------|
| Diphenylamine | 1.02 to 2.22 |
| Ether | 97.38 to 99.38 |

E. Final Mixer (mixer temperature 50° maximum)

- 1. Build alcohol to 114 pounds and add the alcohol to the mixer. The alcohol add weight is determined by subtracting the dry nitrocellulose weight from the total wet weight of the dehydrated blocks and subtracting the difference from 114 pounds.
- 2. If there is no alcohol build, there must be a minimum of 10 pounds added to the mixer.
- 3. With the mixer in operation, gradually add 348 pounds of nitrocellulose (split blocks) to the mixer.
- 4. Mix for 4 to 5 minutes.
- 5. a. Standard Method Allow 216 +/- 1 pound of mixed solvents to start flowing into the mixer,
 - b. Alternate Method Add 3.5 pounds (3 lbs 8 ozs +/- 0.3 ozs) of DPA to 10 pounds of ether in a solvent boot. Stir the mixture with a wooden paddle until the DPA is dissolved (approximately 1 minutes). Add the slurry mix (DPA-ether) plus an additional 202 pounds of ether to the mixer.
- 6. Add one bag of K_2SO_4 (3.5 pounds) to the mix. Distribute the chemical evenly.
- 7. Add 40 pounds of remix (strands, split press blocks, and heels) if available.
- 8. Close the lid and mix for 25 minutes.
- 9. Ten minutes, minimum prior to discharging the mixer, an additional solvent add (ether/alcohol in a 2:1 ratio) may be made, as required, to produce propellant which will extrude within the desired pressure range. Record all solvent adds and exact mixing time on the flow card.
- 10. Continue mixing until a minimum mixing time of 40 minutes (time after the start of solvent mix addition) has occurred.

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- II. When the desired mix consistency has been obtained, pull the mix into tubs.
- 12. Charge the required amount of propellant into the macerator.
- 13. Macerate for a minimum of five minutes.
- 14. Pull the macerated propellant and deliver to the preblocker.

Alternate Mixer

- 1. Produce 16 mixes usi; Beken-Mixer (double-wing) and current GOP.
- 2. Mix time will be 30 minutes or as specified by initiating engineer.

F. Preblocking, Macaroni, and Final Blocking

- 1. Freblocker Sufficient dwell time to make blocks for macaroni prass.
- Macaroni Use one 16-mesh screen.
- 3. Final Blocker 30 seconds (minimum) high pressure dwell time.

G. Press and Cutting House

| | Lots RAD-PE-559-17 | -18 | -19 |
|--|------------------------|--------------|-------|
| Type Press | Vertical Unmodified | 12-inch pres | 3S |
| No. of Screens . | 2 (16 and 40 mesh) for | or all lots | |
| No. of Dies/Press | 20 for all lots | | |
| Agate, inch | 0.147 | 0.170 | 0,190 |
| Pin, inch | 0.014 | 01.016 | 0.018 |
| Pin Circle, inch | 0.090 | 0.104 | 0.115 |
| No. of Pins | 7 for all lots | | |
| Extrusion Pressure, psig | 2,000 - 2,800 for all | l lots | |
| | Lots RAD-PE-559-17 | 18 | -19 |
| No. Mixes | 16 | * | * |
| Type Cutter | Small Arms for all lo | ots | |
| Green Length, inch (+/- 0.001) | 0.110 | 0.135 | 0.150 |
| Outer web, inch | 0.150 | 0.190 | 0.213 |
| Inner Web, inch | 0.150 | 0.190 | 0.213 |
| Cutting Die, inch | 0.150 | 0.190 | 0.213 |
| No. of Blades | 28 for all lots | | |
| Roll Size, inch | 1-1/2 plain for all | lots | _ |
| Gear Train D, for D, x 180 x 160 x 89 | 65 | 80 | 90 |

-- PAN_DE-550_17

^{*}Four blocks, two press loads, or approximately 200 pounds will be extruded for lot RAD-PE-559-18 and the same quantity will be extruded for lot RAD-PE-559-19. These two lots will be placed in sausage bags at cutting.

- Adjustments may be necessary in the gear train and cutting dies to contain correct dimensions. For lot RAD-PE-559-17 the correct average length is 0.108 +/- 0.005 inch for averages of 10. If first average of 10 is outside limits, a second set of ten measurements will be made and the average of 20 will be used for decisions (one gear tooth = 0.0014 inch).
- 2. Use water/alcohol mixture in dripolator on cutting machines.
- 3. Cutting machines must be kept in adjustment so as "tails" do not exceed 5 percent.
- 4. The lot must be properly identified.

E. Solvent Recovery

- 1. Prior to charging the Solvent Recovery Tank, the tank used must be checked to assure that all equipment, including U-gages, recorders, etc., are in proper working order.
- 2. Identify buggies and sausage bags with lot number, and propellant type.
- 3. Load at 21 +/- 3°C. Put identified sausage bag pilot lots RAD-PE-559-18 and -19 on top of SR tank load.
- 4. Maintain inert gas flow to 1/8-inch positive pressure for 32 hours.
- 5. Increase inert gas flow to 1/4-inch positive pressure and maintain for 32 hours.
- 5. Turn on heat exchanger and control at 35 +/- 3°C at 1/4 inch positive pressure for 24 hours.
- 7. Cover with water until ready for transport to water dry.
- 8. Identify buggies with propellant type, PEI No., SR Bldg. and Tank Nos.
- 9. Pull the lot and transport to water dry.

I. Water Dry

- 1. Load propellant lot in Water Dry and cycle at 56 62°C. Put the two lots, RAD-PE-559-18 and -19, in identified sausage bags on top of water dry tank and load.
- 2. Water dry propellant for 10 days.
- 3. Separate water from propellant and allow a 24-hour drainage period. Load 971 pounds into numbered stainless steel dump buggies. Take representative samples from first, third and fifth buggies for "sausage bag" TV. Be sure they are identified by buggy number. Quality Control will weigh 971 grams to within 0.1-gram the and after a 10-hour air dry cycle and the average of the three TV results should be 900 +/- 10 grams after drying.

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Water Dry (Cont) .

- 4. When sausage bag TV results are available, check buggy net weights, record changed weights, and transport buggies to coating house as necessary.
- 5. Also, take three 971-gram "sausage bag", air dry, TV samples from lots RAD-PE-18 and -19. QC will weigh these before and after drying for 10 hours in air dry tank.
- 6. Send a representative 2-pound sample from the sausage bag samples from lots RAD-PE-559-17, -18 and -19 to lab for complete analysis. Label "uncoated."

Coating House

- 1. Check out coating barrel system by UOP to see that all valves are open or closed as required and to determine that temperature controls are functioning satisfactorily before coating operation commences.
- 2. Check out ventilating system and be sure butterfly valve is open.

Coating Technique*

- 1. Charge wet propellant (900 pounds, <u>dry weight</u>), build water weight to 90 pounds and add 128 pounds of alcohol.
- 2. Start barrel rotation.
- 3. Bring barrel temperature to $75 + -1^{\circ}C$ ($167 + -2^{\circ}F$).
- 4. Rotate for 15 minutes at temperature and stop barrel.
- 5. Add methyl centralite and ethyl alcohol slurry in three equal increments of 9 pounds 5.7 ounces of methyl centralite in 16 pounds of ethyl alcohol by means of tank lid using 1-inch orifice and minimum of 5-minute dispensing time.
- 6. Rotate barrel for two hours (+/- 5 minutes) starting from start of addition of last increment of methyl centralite.
- 7. Cool coating barrel to 40°C and cycle 10 minutes.
- 8. Wash propellant with cold water from coating barrel through trough and discharge into buggies.
- 9. Transport to water dry identified by appropriate lot number.

K. After Coating Water Dry

Water dry at 56 - 62°C for 48 hours.

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POPULACIONAL PRINCIPA PRACTICA POPULA POPULA

Air Dry

- 1. Charge 5000-pound lot.
- 2. Maintain temperature of air at 54 +/- 4°C (129 +/- 7°F) for a sufficient time to obtain a moisture content range of 0.85% to 1.25%. Estimated time is 10 hours. A 29 minute M&V and GCTV samples should be taken after 10 hours.
- 3. At the end of drying cycle, allow a minimum of one hour cool-down at 100 +/- 5°F with blowers running.
- 4. Upon completion of drying, send propellant sublots to Blending and Glazing in drop plug buggies.

M. Blending and Glazing

- 1.* Charge lot into a blender barrel and rotate for 10 minutes (ungraphited).
- 2.* Obtain a one-pint sample from the lot, label, and send to Chemical Laboratory for 20 minute M&V analysis.
 - a. If M&V results are within range of 1.00 to 1.30 percent, no adjustment is necessary.
 - b. If M&V results are less than 1.00 percent, the water add can be calculated by the following equation:

Pounds of
Propellant x 1.15 - M&V Results = Pounds of water to add
1.00

- 3. After the moisture cortent has been adjusted, glaze propellant batch with 0.2 percent graphite using a 3-hour glaze cycle (10.0 pounds/5000 pounds).
- 4. Screen propellant. Use following screens:

Acceptance - 0.19 - .266 dia opening and .125 (L) Fine - 0.086 dia opening

- 5. Pull lot into fiber drums and identify by lot RAD-PE-559-17 number.
- 6. Obtain a 25-pound sample from lot after screening has been completed. Label sample for gun, chemical, HOE, closed bomb, bulk density, hygroscopicity, and physical dimensions. Identify sample by proper lot number.
- 7. Glaze the two small lots with 0.2 percent graphite for 1 I/2 hours using a fiber drum and procedure, HXD-4-11-140. A 25-pound final lot sample will be taken from each of lots RAD-PE-559-18 and -19 after glazing. For tests as described in preceding paragraph six.

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^{*}Steps 1 and 2 are necessary only if GCTV from air dry sample is not acceptable.

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M. Marking and Addressing

Marking and address is to be as follows:

One side: PROPELLANT EXPLOSIVE (SOLID) CLASS B
25mm GUN

LOT RAD-PE-559-__*
WEB MP GRAIN

LBS NET LBS GROSS
CU FT PACKED **

*Insert as applicable -17 for 5000-pound lot with 0.019" web, -18 for 50-100 pound lot with 0.021-inch web and -19 for 50-100 pound lot with 0.024 inch web.

TO: FORD AEROSPACE AND COMMUNICATION: CORPORATION

33600 ORTEGA HIGHWAY

SAN JUAN CAPISTRANO, CA. 92675

MALK FOR: CONTRACT DAAK30-80-C-0010

FROM: COMMANDER

RADFORD ARMY AMMUNITION PLANT

RADFOKD, VIRGINIA 24141 CONTRACT: DAAA09-77-C-4007

III. TECHNICAL DEPARTMENT

A. Quality Control

- 1. Monitor and inspect the propellant outlined under this PEI using Standard Inspection Procedure and Special Operating Instructions contained herein.
- 2. Ensure that the propellant is kept separated and properly identified at the cutting machine, in the powder buggies, at solvent recovery and at water dry.
- 3. It is requested that the following data be taken during pressing:
 - a. Granule length, diameter, web, web difference, percent tails, and perforation (20 grains)
 - b. Extrusion pressure (2/shift).
- 4. Composite samples of cut propellant will be observed for closed perforations twice per shift (25 grains/sample). If closed perforations are found, QC will notify Production and initiating engineer.
- 5. Perform 100 percent inspection of coating of propellant.
- 6. Deliver samples from water dry and Finishing area to Building 7105 as outlined in this PEI.



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Internal Ballistics Laboratory

- 1. Prepare and forward all propellant samples to the Powder Laboratory and __ Ballistics Rauge as outlined in this PEI.
- 2. Perform heat of explosion test on coated and uncoated samples from lots RAD-PE-559-17, -18 and -19.
- 3. Perform 5 shots closed bomb tests on uncoated samples from lots RAD-PE-559-17, -18 and -19. Use 200cc closed bomb, 0.2 gm/cc loading density and reference lot RAD-PE-559-11.
- 4. For final lot, perform 6-shot RQ and RF tests at +/- 90°F and 0.2 gm/cc ----loading density in 200cc closed bomb. Use lot RAD-PE-559-16 (AP) for reference lot.
- 5. Obtain engineering unit printouts for closed bomb tests.

C. Powder Laboratory

1. Perform chemical and physical analysis on lot samples as outlined in the following Sampling and Testing Instructions table.

Ballistics Area

Perform (70°) velocity, action time, chamber, and muzzle pressure tests in 25mm gun components on final lot. Samples will be fired at charge weights determined by RQ and HOE. Make single shot firings for velocity, action time, chamber, and muzzle pressure combined at charge weights determined by initiating engineer and Ballistic Range supervision. It is also desired that ignition delay time be ascertainable. Use the following test plans for tests:

| Test Number | Charge Weight | Lot RAD- PE-559- | Temp., °C | •F |
|----------------|------------------|---------------------|-----------|--------------------|
| 1 | 96.9 | 16 | +21 | ÷70 |
| 2 | 96.9 | 16 | +21 | +70 |
| 3 | 96 | 17 | +21 | +70 |
| 4 . | 96 | 17 | +21 | +70 |
| 5 | · 96 | 17 | +21 | +70 |
| 6 | 96.9 | 16 | +21 | +70 |
| 7 | 96.9 | 16 | +21 | +70 |
| 8 | 98 | 17 | +21 | +70 |
| 9 | 98 | 17 | +21 | +70 |
| 10 | 98 | 17 | +21 | +70 |
| 11 | 96.9 | 16 | +21 | +70 |
| 12 | 96.9 | 16 | +21 | · 1 ·70 |
| 13-17 | * | 17 | +21 | +70 |
| 18 | 96.9 | 16 | +21 | +70 |
| 19 | 96.9 | 16 | +21 | +70 |
| 20-25 | * | 17 | +21 | +70 |
| 26 | 96.9 | 16 | +21 | +70 |
| 27 | 95.9 | 16 | +21 | +70 |
| 28-32 | * | 17 | -54 | -65 |

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| Test Number | Charge Weight | Lot RAD- PE-559- | Temp., °C | | °F_ |
|----------------|------------------|---------------------|-------------|---|-------|
| 33- 37 | ** | STD 12-12-74 | -54 | | -65 |
| 38-42 | * | 17 | +71 | | +160 |
| /3_/7 | ** | STD 12-12-74 | 47 7 | • | 73 60 |

^{*}Weight to be determined from 96 and .98 gram charge tests.

^{**} Use existing loaded rounds and measure velocity, only.

| | no | number, | ., Date, | on Date, on Stance |
|----------------------------|-----------------------|--|--|--|
| | Identification | PEI number, Lot number, | PEI No. Cut No., Date, "Pre-Glare", 25mm | PEI No., Lot No., Date, Shift, Time, 25mm "Final Lot Acceptance Sample" |
| SMPLING AND ESTING SUPMARY | Teet | Complete chem., phy., dimension, Bulk density, Corverted HOE, clos into and stable sy. | 20' M&V, GCE | % Methyl Centralite % Graphice GCTV 6 Hour M&V Bulk Density Fhysical Dimensions Gun Test Closed Bomb HOE Nygroscopiaity % ZDPA % XK2504 RS |
| SMPLING AND | Amount of Sample | 2 pounda/ lot ' | i pint, ea. sample | 25 pounds |
| | Frequency | Composite of 3-bag samples of each lot | l sample | l sample lot |
| | Where Sample Taken | Air Oried (Sausage bag) samples from water dry | Rlender Barrel | Final Screen |
| | Item Sampled | defore Coating | Zach Lot ('' .greohited) | Pinished Propellant 201 |

M-10 Propellant for 25mm QC Check Sheet PEI-559-17 Thru 19

| | | PEI-559-17 Thru 19 | | | | | 1.5% |
|----|------------|--|---|-----------------------------------|--|--------------|-------------|
| | | | | | | | 30 |
| | | | Record | accusi | data wher | e possible | т |
| | | | Mix | Kumbers | or Lot N | nupera | 1 |
| 1. | (a) | Date | | | | | 1 |
| | • | · | | Angel Street Street Street Street | - | | † |
| | (b, | Shift | | | | | ÷ |
| | Solve | ent Hix Final Mixer and Macerator | | 4 | | | |
| 2. | (a) | Check temperature (50°F max) | | | | | 1 |
| | | Alcohol added to build to 114 lbs/mix | | | | | 1 |
| | (c) | Nitrocellulose | | | | | + |
| | | Blend No. Linters - Z Nitrogen (13.15 +0.05%) | | | | | 1 |
| | | 3. Solubility (40 to 49%) | | | | | t |
| | | 4. Fineness - Control: 82 - 90 ml | | | | | <u> </u> |
| | | Accept: 77 - 95 ml | | | | | |
| | | 5. Freeness - 416 to 550 ml | | | ļ | | - |
| | (4) | 6. % TV - Dry wt. NC added (348 lbs) | | | | | - |
| | | Wet wt. MC added (546 ibs) | | | | | |
| | | Mix Time (4-5 min.) Stop watch timed | | | | | Ì |
| | (g) | Mixed solvents added | | | | | - |
| | | DPA - 3 lbs 8 oz. +/- 0.3 oz | | | - | | |
| | (h) | Ether - 212.3 lbs Potassium Sulfate added - 3 lbs 8 oz | J. ———————————————————————————————————— | | | | |
| | (11) | +/- 0.3 oz. | | | | | - |
| | (i) | Remix (clean, no screens or foreign | | | | | |
| | | material) | | | | | |
| | (j) | - in 100% remixes - check type | | | | | • |
| | | (clean propellant) No evidence of other formulations in remix | | | | | |
| | (k) | | | | | | - |
| | (1) | Solvent add if any. The wheel and the | | | | | • |
| | | The second section is the second seco | | | | | |
| | (T) | | <u></u> | <u> </u> | | | • |
| | (n) | macerator Macerator properly loaded (No Bridging) | | | | | - |
| | (o) | | | <u> </u> | | | • |
| | • • | • | | | 1 | | • |
| | | PRESSING | | | | | |
| | | Use vertical 12-inch press | | | | | |
| 3. | Dies | used (verify each) | | | | | |
| | | , and the same of | | | | 1 " | |
| | | - RAD-PE-559 -17 -18 or -19 | | | ļ | | <i>(</i> 1) |
| | | Agate 0.147 0.170 0.190 | | | <u> </u> | | (4) |
| • | | Pin (7/die) 0.014 0.016 0.018 Pin circle 0.090 0.104 0.115 | | | | | • |
| | | 2 screens (16 & 40 mesh) | - | | | | |
| | | Extrusion Pressure (2000 - 2800 psig) | | | | | • |
| | • | using vertical li-inch press | | | | | |
| | | 202 | | | | | • |

M-10 Propellant for 25mm QC Check Sheet PEI-559-17 thru 19

| | | Record actual data where possible | |
|-----|--|-----------------------------------|-----------|
| | | Mix Numbers or Lot Numbers | |
| | CUTTING | | ٦ |
| | | | ı |
| 4. | Small Arms Cutter verify setup; 17 18 19 | | |
| | (a) Outer web, inch 0.150 0.190 0.213 | | 1 |
| | (b) Inner web 0.150 0.190 0.213 | | brack I |
| | (c) Cutting Die 0.150 0.190 0.213 | | J |
| | (c) Cutting Die 0.150 0.190 0.213 (d) No. of Blades 28 28 28 | | |
| | (a) Pall Diamatan 1 7/98 Diada | | |
| | (f) Gear train D ₁ 65 80 90 | |] |
| | For 0 x 180 x 160 x 89 | | \rfloor |
| | (g) Length of grain, 0.110 0.135 0.150 inch (+/- 0.001) | | 1 |
| 5. | GREEN PROPELLANT DIMENSIONS | | |
| | Average of 10 Measurements Desired Average | | ١ |
| | 17 | | ┪ |
| نبد | (a) Length $0.109 + /002$ | | 7 |
| | (b) Outside diameter 0.122 +/004 | | † |
| | (c) Outer web: $0.021 \pm /002$ | | 7 |
| | (d) Perf. diameter, 0.011 +/006 | | 7 |
| | (d) Perf. diameter ₁ 0.011 +/006 (e) Inner web ₁ 0.020 +/002 | | 1 |
| | (f) Perf. Diameter 0.011 +/002 (g) Inner Web ₂ 0.0196 +/003 | | 7 |
| | (g) Inner Web ₂ | | † |
| | (h) Perf. diameter 3 0.010 +/002 | | † |
| | (i) Outer Web ₂ $0.020 +/002$ | | Ť |
| | (j) %"Tails" not to exceed 5% | | † |
| | (k) Lot properly identified | | 1 |
| | (1) Remix left from mix | | † |
| | 1. Press heels, lbs | | Ť |
| | 2. Press extrudate remix, 1bs | | Ī |
| | 3. Cutting machine remix, lbs | | I |
| 6. | SAMPLES TAKEN FOR"SAUSAGE BAG" TV | | |
| | (a) From water dry (after 10 days) | | |
| | 1. Buggy one (971 gms) record weight weight after 10 hrs air dry | | |
| | Buggy three (971 gms) Record wt. weight after 10 hrs. air dry. | | |
| ••• | Duggyfive (971 gms) Record wt. weight after 10 hrs. air dry. | · | |
| | (b) Two pound samples sent to lab for | | † |
| (*/ | complete analysis from each lot. | | 1 |
| | (Composite 3 bags "sausage bag" Air Dry | : | 1 |
| | emples litabel before exertaci | | 1 |

M-10 Propellant for 25 mm QC Check Sheet FEI-559-17 Thru 19

| -Record actual data where possible | | | | | | and the | |
|------------------------------------|-----|---|----------|-------------|-------------|-------------|--------------|
| | Mix | Numbers | or | Lot | Numbers | | |
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. COATING

- (a) Correct wet weight of powder added to barrel (900 pounds, dry wt.)
- (b) Water weight built to 90 lbs
- (c) Alcohol added (128 pounds)
- (d) Barrel temp. brought to 75 +/- 1°C and rotated 15 min.
- (e) Add 1 9 lb. 5.7 oz of Methyl
 Centralite in 15 pounds Ethyl
 Alcohol with 5 minutes dispensing
 time

Add 2 - Repeat of add 1 Add 3 - Repeat of Add 1

- (f) Rotate barrel for 2 hours +/- 5 min. Time started Time stopped
- (g) Cool barrel to 40°C and rotate 10 min. before discharging with cold water.
- (h) Lot identity correct before transporting to water dry.
- 8. Verify Water Dry Time and Temperature 56 62°C for 48 hours.
- 9. Verify Air Dry time and temperature 54 +/- 4°C for 10 hours.
- 10. Sample after 10 hour air dry for a 20 min. M&V and GCTV
- II. Blending and Glazing and Screening
 -- Check Lot Numbers-
 - (a) Amount of blender charge correct
 - (b) Preblending time correct
 - (c) Lot moisture adjustment correct
 - (d) Amount of graphite correct (101bs/50001b)
 - (e) Blending and Glazing time correct (3 hrs)
 - (f) Screens clean and correct
 - (g) Drums identified correctly
 - (h) 25-pound final lot sample taken from each lot.

DISTRIBUTION

Radford

- W. H. Fuller J. B. Hathaway Central File
- L. C. Pugh
- E. M. Soucek
- W. T. Bolleter
- C. D. Chandler, Jr. File (PE-559)
- J. W. Pierce
- J. G. Johnson

Technical Library

Salt Lake City

R. G. Sailer

Alleghany Ballistics Laboratory

G. H. Moody Librarian

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